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AND

FACT-INDEX

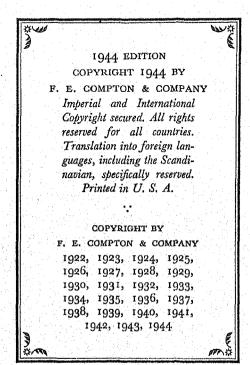
INTERESTING · ACCURATE · UP-TO-DATE

To inspire ambition, to stimulate the imagination, to provide the inquiring mind with accurate information told in an interesting style, and thus lead into broader fields of knowledge—such is the purpose of this work

VOLUME 11

F. E. COMPTON & COMPANY · CHICAGO





Here and There in This Volume

T ODD TIMES when you are just looking for "something interesting to read," without any special plan in mind, this list will help you. With this as a guide, you may visit

any special plan in mind, this list will help you. With this as a guide, you may visit far-away countries and watch people at their work and play, meet famous persons of ancient and modern times, review history's most brilliant incidents, explore the marvels of nature and science, play games—in short, find whatever suits your fancy of the moment. This list is not intended to serve as a table of contents, an index, or a study-guide. For these purposes consult the Fact-Index and the Reference-Outlines.

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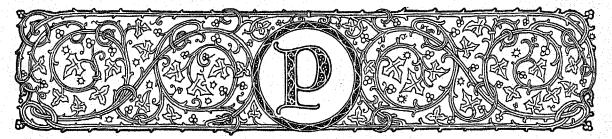
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Key to Pronunciation

Pronunciations have been indicated in the body of this work only for words which present special difficulties. For the pronunciation of other words, consult the Fact-Index. Marked letters are sounded as in the following words: cāpe, ăt, fâr, fâst, what, fall; mē, yĕt, fērn, thêre; īce, bੱt; rōw, won, fôr, nŏt, da; cūre, bǔt, rude, full, būrn; ü = French u, German ü; gem, go; thin, then; n = French nasal (Jean); zh = French j (z in azure); x = German guttural ch.



The LURE of the PACIFIC and Its JEWELED ISLANDS

PACIFIC OCEAN.
Stretching 9,300 miles
from the Arctic Circle at
Bering Straits to the
frozen seas of the South

Forget the smoke and noise of the city and the busy toil of farm and factory, and fly on the magic carpet of your dreams along the golden trail of the setting sun, which leads over the blue vastness of the Pacific to the enchanted islands of romance.

of the city and the busy toil you the magic carpet of your lof the setting sun, which f the Pacific to the enchantromance.

while the rolling swells break in never-ending roar on the dazzling shores, and overhead the slender coco-palms whisper their soft and drowsy song. Truly this great

Polar zone, and nearly halfway around the earth along the Equator, from the coast of South America to the tip of the Malay Peninsula, this giant of waters occupies one-third of the earth's surface, a region of mystery and adventure greater than all the land area of the world combined. It is the deepest of oceans, averaging two and a half miles, and reaching its maximum in a yawning chasm 35,400 feet deep, east of Mindanao in the Philippines—6,398 feet deeper than Mt. Everest, the world's tallest mountain. It washes the shores of four continents—North and South America, Asia, and Australia—and its waters mingle in the southeast with the Atlantic Ocean, and in the southwest with the Indian Ocean.

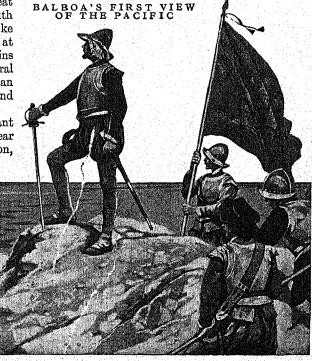
sea deserves its name, given by Magellan, of the Pacific or "peaceful" Ocean.

When white men first landed on its islands, they appeared as Paradise was before the curse of Adam compelled men to earn their bread by the sweat of their brow. The inhabitants were like happy children who never grew up. Tall magnificent men and handsome women they were for the most part, and apparently they had not a care in the world. Coconuts and breadfruit grew wild at the doors of their huts. The surrounding waters were filled with turtles and fish, ready for the net. For clothing they had little need. Disease was virtually unknown.

But it is not on the shores of America or of Asia or of Australia that you will find the soul of the great Pacific; it lies far out where those fabled "South Sea Isles" are scattered over the vast expanse like stars in the sky. There, where the monster fires at the heart of the earth have thrust great mountains and volcanoes above the waters, and where tiny coral creatures with ceaseless labor have crowned the ocean with countless coronets of rainbow hues, the fairyland of dreams almost comes true.

Occasionally cruel and bloody wars broke out between neighboring tribes, or swift cance raids were

The very air that sweeps these islands is fragrant with flowers and spice. Bright warm days and clear cool nights follow each other in eternal procession,



Balboa was the first white man to gaze upon the waters of the Pacific Ocean. Standing upon a peak in the Isthmus of Panama on Sept. 25, 1513, he sighted the "Great South Sea," and four days later reached its shore, taking possession of it in the name of Spain.

THE "OUTRIGGER" CANOES OF THE ISLANDERS



Nearly all the canoes used by the Pacific islanders are extremely long and narrow. Indeed, they would always be tipping over if it were not for the outrigger structure—a set of poles projecting from the side, at the end of which is fastened a float which rests on the surface and holds the craft steady. When they want to make speed, the paddlers tip their canoe slightly so the outrigger is raised clear of the water. The men shown here are natives of the Admiralty Islands.

made on nearby islands; but the brown warriors were athletic and brave, and found fun in fighting. It is true many of them were cannibals, who cooked and ate the enemies they killed; but this was part of their island law and religion. At most times these smiling savages were friendly, courteous, and hospitable.

All these things the first explorers found and wondered at, frequently becoming so fascinated with the South Sea lure that they forgot their homes and settled down among the natives for the remainder of their days. But today the bloom of the Pacific is gone, like a delicate flower that drooped and faded at the white man's touch. The jeweled islands are still there, and the coconut palms and the dazzling beaches kissed by the soft breezes; but the peoples who used to live in such carefree happiness are rapidly vanishing. On certain islands, where a hundred years ago thou-

sands lived, a few score perhaps are left. Diseases—tuberculosis, small-pox, measles, leproxy, and many others—were left in the wake of the great sailing vessels or in the trail of the steamer's smoke.

A SAMOAN WARRIOR ON DRESS PARADE



This is the sort of costume the Polynesians used to wear for ceremonial occasions in the old days.

The bodies of the islanders, from time immemorial free from the attack of disease, had slight power to resist sickness; so they fell, and continue to fall, easy victims to the scourges of civilization. Even measles, which we count a minor ailment, killed them by the thousand.

Such was the tragedy of the Pacific. In another bundred years there will be left scarcely a single pureblooded member of what a great missionary once called "the noblest of all primitive races."

The story of the Pacific confronts us at the outset with one of the mysteries of archaeology. Scattered through the island groups from one side of the ocean almost to the other are found the remains of an ancient race of skilled builders. Ruins have been discovered of huge altars, tombs, and dwellings built of great blocks of stone carefully fitted together without mortar. Traces exist in some places of houses built

out over the sea, of canals, and of gigantic piers and breakwaters. On tiny Easter Island, 2,000 miles from the coast of South America and over 1,000 miles from any other inhabited island, are found great walls and W. DAMPER

platforms 30 feet high, surmounted by pedestals upon which once stood colossal statues, now lying near by. These statues, crumbling with age, still show resemblance to the human form. The largest is 37 feet high, and in a quarry on the other side of the island is a figure half cut out from the volcanic rock, which measures 70 feet. On some of the stones are traced geometrical figures and the shapes of animals.

Who were these builders, whence did they come, and whither did they go? The natives who lived on these islands when the white men first arrived knew no more about the puzzle than we do today.

Let us now take a glance at the map of the Pacific. The western shores of the Americas, we see, are remarkably unbroken, the coast islands off southern Chile, the Gulf of California, and the long chain of Aleutian Islands off Alaska being the only important features. With the exception of the Aleutians, the Galapagos, and the Juan Fernandez groups, there are no deep-sea islands off the American coast for a stretch of 2,000 miles.

To this shore line, the coast of Asia presents a great contrast. It is broken by numerous great bays and land projections and skirted by a series of large islands, which mark off parts of the Pacific important enough to be named as separate seas. From north to south these are Bering Sea, bounded by the Aleutians; the Sea of Okhotsk, set off by the peninsula of Kamchatka and the Kuril Islands; the Sea of Japan, between the islands of Japan and the mainland; the Yellow Sea, formed by Korea; and the China Sea, inclosed by the coast of Indo-China, the Malay Peninsula, the island of Borneo, and the Philippines.

The waters between the southeastern corner of Asia and the continent of Australia are crowded with a group of large islands, variously called the East Indies or Malaysia or the Malay Archipelago. The Philippines and Borneo have been mentioned. The others are Sumatra, Java, Celebes, and New Guinea. These, as well as New Zealand, are not usually classed as Pacific islands; their story is told under their separate names. (See also East Indies.)

The smaller Pacific islands, often called by the general name of Oceania, form a sort of watery "Milky Way" 8,000 miles long, from Japan and the Philippines to distant Easter Island. They are mostly divided up into clusters or groups, each with its own name. These groups in turn fall into three great divisions, according to their position and the character of their native population.

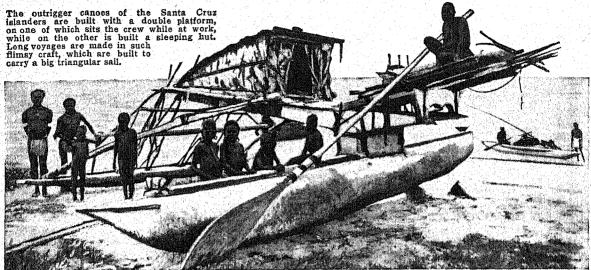
The first division is Melanesia ("islands of the blacks"), forming a long crescent of good-sized islands, stretching from the coast of New Guinea southeastward toward New Zealand. The principal

THE MYSTERIOUS STONE MEN OF EASTER ISLAND



Who were the ancient sculptors who carved these stone images found on Easter Island, separated as it is by 1,000 miles of deep ocean from the nearest inhabited land? So far no one has found an answer to the puzzle. Cut out of gray stone, many of the figures were crowned with red stone "hats," as you see here.

A HOUSEBOAT OF THE SOUTH SEAS



groups in Melanesia are the Bismarck Archipelago, including New Britain and New Ireland, with their batteries of active volcanoes: the Solomon Islands, where dwelt the most savage and uncivilized cannibals; the Santa Cruz Islands, where many early missionaries fell victims to poisoned arrows; the New Hebrides, with their government conducted jointly by France and Great Britain; and, at the end of the crescent, the large island of New Caledonia, an old French convict colony, with the Loyalty Islands near by.

The natives of Melanesia are for the most part negro-like in appearance, with thick lips, very dark skin, and curly hair. They are closely related to the Papuans of New Guinea. Their social and political customs are crude, but they have all the negro's skill in savage arts. They are perhaps the most energetic and industrious, and yet the least civilized, of the Pacific islanders.

North of Melanesia lies the division called Micronesia ("small islands"). This consists of close-packed groups of tiny islands, some of volcanic origin, others merely atolls, as the peculiar ringshaped Moral islands are called. The principal groups are the

Marianas or Ladrones to the north, which include the United States' possession of Guam (see Guam);



This Melanesian youth from one of the islands near New Guinea must be the talk of his village. For above all things, his people admire small waists and well-spiked noses.

the Pelew Islands, with their amazingly fertile soil; the widely scattered Caroline Islands, famous for their strange prehistoric ruins; the Marshall Islands, where dwell the boldest and most skilful navigators of the Pacific; and the crowded Gilbert Islands, formerly noted for the fierce cruelty of their inhabitants.

In general the natives of Micronesia are of mixed black, brown, and yellow strains. Malay and Chinese characteristics mingle with strong traces of Papuan blood, but these peoples are generally more handsome and of higher intelligence than the Melanesians.

The "Many Islands"

The remaining great groups of islands, which occupy the center of the Pacific, fall into the division called Polynesia ("many islands"), and it is among these that the true South Sea romance dwells. The Polynesian men are among the tallest in the world. averaging on some islands six feet in height. The women are often beautiful, even according to the highest European standards. The race is light brown in color, with straight black hair; and some scientists trace it to the same Caucasian stock in the New Stone Age from which the white race

of Europe sprang. The intelligence of these Kanakas, as they are sometimes called, is high, and their

manners set an example to many white visitors. In their happy and indolent life they long ago lost

the desire to work, as well as much of their skill in manual arts; but their political and social organization was in the past the highest in the Pacific.

The chief groups of Polynesia are the Hawaiian Islands. the Fiji Islands, and the Samoan Islands. (Each of these is treated in a separate article.) Of the other groups, the most important are the Ellice Islands, chiefly of coral formation; the Tokelau Islands, whose inhabitants are perhaps the boldest swimmers in the world, parties of men and women frequently pushing out into the open sea and attacking man-eating sharks with no other weapons than long knives; the Tonga or Friendly Islands, with their wonderful political organization under native rulers; the Cook Islands, one of the most picturesque groups in the Pacific: the Society Islands, including beautiful and romantic Tahiti.

far-famed for the songs and poetry of its people; the Tubuai or Austral Islands, famous for their native sailors; the Tuamotu or Low Archipelago, consisting of innumerable coral islands noted for their shell fisheries; and last of all the Marquesas Islands, whose natives are said to surpass all other islanders in beauty, but whose population has been reduced by disease from 50,000 in 1850 to less than 3,500 today.

The religion of most of the Pacific islanders was marked by strong superstitions and faith in magic. Most conspicuous was the widespread practice of tabus, or religious prohibitions. This was often used in place of laws to protect the persons of chiefs, to safeguard crops, to shut out

the people from certain temples or houses, and for scores of other purposes. To eat tabu food, to lay

A GIRL OF TAHITI



The women of the western Pacific islands are graceful, intelligent, and often beautiful, even according to white standards. This girl is typical of many found in the more civilized islands. She shows a touch of Chinese blood. The Chinese have intermarried to a great extent with the Polynesians.

ROYALTY IN THE PACIFIC



Here you see a king and queen of the Marshall Islands in European dress, taking a walk through their island domain. They still retain their titles, though all real power is in the hands of a Japanese governor.

hands on a tabu person, to enter a tabu dwelling, brought upon the offender, according to native belief, grave misfortune or even death (see

Magic).

According to many native legends, the Polynesian race spread out originally from the island of Savaii, in the Samoan group, colonizing one after another the islands to the north and east. Modern scientists believe that these peoples came from the mainland of Asia. some 3,000 years ago or more, passed through the Malay Archipelago, and thence made their way in great canoes to the outlying groups. The prehistoric builders were perhaps exterminated or driven away. One theory connects these Polynesian peoples with the Inca race of South America.

A great contrast exists between the coral atolls and the volcanic islands of the Pacific.

The ringshaped or horseshoe atolls, which may be from one to 100 miles in circumference, are low, sometimes rising only a few feet above the surrounding waters. They are fringed with cocopalms, and here and there in the shallow soil grow pandanus trees, which provide not only a fruit. but timber, dye, and leaves for thatching and making hats. Rats and land crabs are the only animals, but the surrounding waters teem with varied fish. The coral reef usually has one or more openings, leading to the lagoon within, which forms a natural harbor. In the lagoon, too, fish abound, but for some reason their meat is frequently poisonous, while the same species caught outside the lagoon will be safe food.

GAMES AND GAMBLING IN THE TONGA ISLANDS



South Sea Islanders are so fond of games of skill and chance that in the old days they would sometimes stake even their freedom, the loser becoming the slave of the winner. The men here are playing lafe, which consists of pitching coconut disks so as to knock an opponent's disk off the mat.

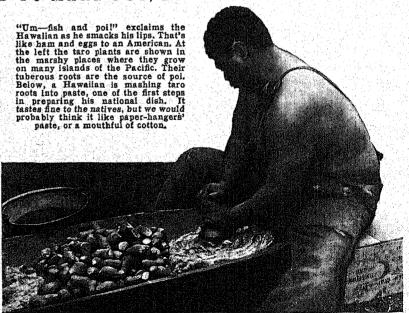
The volcanic islands have an entirely different appearance. Their sharp rocky mass rises suddenly from the sea, often to great altitudes, forming impressive mountains, whose rough outlines are softened by a dense growth of luxurious vegetation. Here rain is more abundant and the rich soil supports countless valuable plants and trees—the taro, whose roots ground into paste and allowed to ferment form the famous native dish called poi; the banana, yam, sago-palm; and the indispensable breadfruit. Here

also grows the paper mulberry, whose inner bark is pounded into tapa cloth, so widely used for mats and clothing throughout the islands. Wild pigs and goats, descendants of those set free by the early explorers, overrun many of the larger islands, and countless birds of bright plumage dwell in the forests of the interior.

But everywhere, on islands large or small, the cocopalm waves its plumes over the land where it remains king. This palm is the fairy godmother of the native. It gives him food, drink, a roof for his house, and fiber

IT'S A HARD GRIND TO MAKE POI, NATIVE DISH OF HAWAII





THE BIG BASKETS THE SAMOANS CALL HOME



The natives of Samoa display extraordinary skill in weaving these round basket-work huts, which they thatch with palm leaves. Such huts are airy, waterproof, and very well suited to the mild climate of the islands. With a home like this in the midst of a grove of coconuts or breadfruit trees, there is no need to worry about the future.

for his baskets, ropes, and fishing nets. And in addition the dried coconut kernel, called *copra*, is the chief article of island trade, and often takes the place of money in business transactions.

Another valuable article of commerce is trepang or beche-de-mer, highly valued as food by the Chinese. It is prepared from the dried bodies of certain large sea slugs (see Sea-Cucumber).

In recent years many of the western Pacific islands have been found to be composed largely of phosphate of lime, highly prized as a fertilizer, and this has been dug out and exported on a large scale. Several of the larger islands yield important quantities of metal ores. New Caledonia, for instance, is one of the world's chief sources of nickel.

The climate of the central Pacific is generally very equable, for the natural heat of the tropics is tempered by the constant ocean winds. But in the west typhoons and hurricanes frequently do great damage and occasional tidal waves set in motion by submarine volcances sweep over coast settlements.

Vasco Nuñez de Balboa from a mountain top in the Isthmus of Panama discovered the American waterway of the Pacific Ocean in 1513. Seven years later Ferdinand Magellan sailed around South America and crossed the Pacific to the Philippines, where he was killed. He sighted few islands on the way, and stopped only at the Marianas. As early as 1512 the Portuguese were entering the Pacific from the western side, following Vasco da Gama's voyage around the Cape of Good Hope. Little was accom-

plished, however, in the way of wider exploration until the 17th century, when the Dutch entered the field, in the person of Abel Tasman, and explored Tasmania (Van Diemen's Land), New Zealand, the Tonga Islands, the Tuamotu group, and the Bismarck Archipelago. The following century Jacob Roggeveen explored Samoa and the neighboring islands. Samuel Wallis and Philip Carteret, acting for Great Britain, and De Bougainville for France carried out other important voyages of discovery.

The greatest of all these explorers, however, was Capt. James Cook, who between 1769 and 1778 made three long trips, visiting nearly all the important eastern groups, including the Hawaiian Islands, where he was killed (see Cook, Capt. James). Vancouver and many others followed where these bold mariners had opened the way.

With the close of the period of discovery, in the second quarter of the 19th century, numerous scientific expeditions were organized to study the formation and the life of the Pacific Islands, the most famous being those of Charles Darwin, in the British warship Beagle, and A. R. Wallace. On their heels came traders, seeking copra, trepang, pearls, tortoise shell, and sandalwood. Whalers and sealers also visited the islands, to refit their vessels and get wood and water. Upon them rests much of the blame for the islanders' misfortunes, for many of the traders, and their rough half-pirate crews, treated the natives with great barbarity, imported alcoholic drinks, and helped to spread disease.

OF THE FEET THE HANDS DANCING WITH



In the Pacific islands as in Oriental countries, the feet are not used at all in many of the native dances. A chorus of men or women will tell a long dramatic story by movements of the hands and upper part of the body. Often the entire dance is performed seated.

Hawailan girls seen above are doing a standing dance. The men in front are playing on drums made of large gourds.

Deserters and shipwrecked sailors often settled in the more hospitable islands, defrauding the inhabitants in trade and exerting evil influences on island politics. These men, who lived from hand to mouth on the bounty of the natives, came to be known as "beach-combers," a name still applied to the shiftless and drifting white population found scattered over the Pacific.

The practice of kidnapping natives for the South American and Australian labor markets, which prevailed for many years, led to many bloody conflicts with the island tribes. Together with the activities of the "beach-combers," these made exceedingly difficult the work of the missionaries, who began their work among the islanders at an early date. Today virtually all the inhabitants of Polynesia and Micronesia profess Christianity, though many of the old religious beliefs are secretly kept alive.

One of the most romantic tales of the Pacific centers about Pitcairn Island, a tiny isolated rock rising 2,000 feet from the sea, southeast of the Tuamotu Archipelago. Here, in 1790, nine mutineers from the British ship Bounty, accompanied by six Polynesian men and 12 Polynesian women, sought refuge from the law. They burned their vessel and started to build homes. Disorder and bloodshed followed, and within ten years only one Englishman, John Adams, with eight women and a number of children were left alive. When this strange colony was discovered, in 1808, Adams had restored order and Christianized his people. The island was annexed to Great Britain in 1839, and 17 years later its people. about 200, were removed to Norfolk Island, northwest of New Zealand, but a number of them returned later. Today Piteairn has about 200 inhabitants, nearly all descendants of the original settlers.

As explorers and traders discovered the Pacific islands and claimed them for their governments, the principal island groups came to be divided among the major naval powers. Before the first World War Germany owned several of these groups, but in the peace settlement the German dependencies were mandated to Japan, Australia, and New Zealand.

Islands of the South Pacific

Most of the islands south of the Equator are under British rule, either as possessions or as mandates from the League of Nations. Some are administered by Great Britain; others by Australia or New Zealand. The map of the Pacific Ocean, on pages 10b and 10c, shows the status of each group.

France has two widely separated groups of possessions in the south Pacific. One group, in the east, includes the Society Islands, with lovely Tahiti, and the Marquesas, Tuamotu, and Tubuai islands. Far to the west is the other group, consisting of New Caledonia with neighboring small islands and the New Hebrides. The New Hebrides are a British-French condominium, that is, they are jointly ruled by France and Great Britain.

United States possessions in the south Pacific include only part of Samoa, and tiny Jarvis Island almost on the Equator. With Great Britain the United States shares control of Canton and Enderbury islands in the Phoenix group; it is developing these as landing bases on the air route to Australasia.

The North Pacific Groups

North of the Equator, most of the islands are under the sovereignty of the United States or Japan. Except for a few small British islands, the United States has all the islands east of the International Date Line. West of this line, Japan administers nearly all as far as the Philippines, either as part of the Japanese Empire or as mandates of the League of Nations. The United States has the Aleutians (see map of Asia) and also Wake and Guam on the air route between Hawaii and the Philippines. British possessions in this area are limited to the part of the Gilbert group lying north of the Equator.

Aside from the Hawaiian Islands, most of the United States possessions in the north Pacific are mere specks, of no value except as airports or air bases. American army planes, circumnavigating the globe in 1924, were the first to cross the Pacific by air. They made the transpacific portion of the flight in high latitudes, using the Aleutian and Kuril islands as steppingstones. In 1935 Pan American Airways made the first flight over its airline from Alameda, Calif., to China, with bases at Honolulu, Sand Island in the Midway group, Wake Island, Guam, and Manila. (For map, see Airplane.)

The United States and Problems of the Pacific

A FINE SPECIMEN OF MANHOOD

THE SEARCH for a new route to the Orient was responsible for the discovery of America. Interest in the Pacific Ocean as a highway to the riches of the Far East was therefore part of the heritage of the Ameri-

can colonists. Even before the Revolution, American whaling voyages stimulated adventurous traders to thought of distant lands beyond the Western Ocean. But not until independence was won, and the young nation faced the need for new markets, did Pacific trade become a reality. In 1784 the Empress of China from New York City reached Cantonthe first American vessel to engage in trade with China. Three years later the Columbia sailed from Boston, rounded Cape Horn, picked up a cargo of furs from the Indians of the northwest coast, and traded them in China for a shipload of tea. This was the pioneer voyage of a colorful, profitable, and steadily increasing trade, in which the furs of the Pa-

cific northwest were exchanged for the tea, coffee, silk, cotton goods, spices, porcelain, and tin of the Orient.

As this new commerce expanded, the nation at home was fulfilling its "manifest destiny" to push the American frontier to the Pacific coast. Expansion to the coast had hardly been completed before some American statesmen viewed it as the "imperial destiny" of the United States to extend its power into the

waters beyond. Senator Seward (see Seward, William Henry), one of the most enthusiastic "imperialists," foresaw this nation as predominant in the Pacific, which, he said "will become the chief theater of events

in the world's great hereafter." In 1853 Commodore Perry led a naval expedition to Japan which resulted in the signing of a commercial treaty—the first that Japan had concluded with any Western nation.

During the second half of the 19th century, issues at home absorbed the people, and the extension of American power in the Pacific was the work of a few zealous statesmen. Seward almost alone negotiated the treaty with Russia in 1867 which resulted in the acquisition of Alaska. He also sponsored a law authorizing American citizens, in the name of their government, to take possession of unclaimed and unoccupied Pacific islands for their deposits of guano.



This bronzed muscular lad of Bora Bora, in the Society Islands, illustrates the physical perfection gained by Polynesian natives in their lives of outdoor play and work. He was chosen to be hero of a motion picture filmed in the Pacific islands, because he so splendidly typified the stalwart men of this region. The picture shows him hurling a spear at a fish.

Under this act, between 1856 and 1884, claims were made for 57 Pacific islands, though most of these were abandoned after the guano had been removed. Some of the small islands thus claimed for the United States have recently become important as bases for naval and civil aviation. Among them are the Midway group northwest of Hawaii—two small islands surrounded by numerous islets—and, to the south, the tiny islands



Johnston, Palmyra, Howland, Baker, and Jarvis. Wake Island was especially important as the only air base between Hawaii and Guam.

The naval and commercial expeditions which brought these specks of land under the American flag were responsible also for several larger acquisitions. The United States had long taken an active interest in the Hawaiian and Samoan islands and had vied with other nations for control. There was widespread opposition, however, to involving the country in the affairs of such distant lands. Not until the outbreak of war with Spain in 1898, and the consequent upsurge of imperialist sentiment, did the nation embark on a frankly expansionist program in the Pacific.

Results of the War with Spain

The United States went to war with Spain for the avowed purpose of setting Cuba free; but the war ultimately had a far-reaching effect on the American position in the Pacific. Commodore Dewey's destruction of the Spanish fleet in Manila Bay fired the imagination of the American people and provided the setting for bold action. In July 1898 Congress finally ratified the treaty which made the Hawaiian Islands part of the American domain. The peace treaty ending the war with Spain provided for the cession of the Philippine Islands and Guam. The following year, 1899, the United States settled long-standing differences with Great Britain and Germany over Samoa. A treaty gave the United States control of Tutuila, with its excellent harbor, and of several other small Samoan islands. (See also Dewey, Admiral George; Guam; Hawaiian Islands; Philippine Islands; Samoa.)

With these swift moves, the United States entered the 20th century as one of the major powers in the Pacific. The opening of the Panama Canal in 1914 stimulated commerce with the Orient and strengthened enormously the naval position of the United States. After the first World War, the country played a leading rôle in Far Eastern affairs. Its trade with the Orient, based largely on the exchange of American industrial products for commodities such as rubber, tea, tin, and silk, continued to expand. In a recent year, American investments in the Far East—including China, the Philippine Islands, the Netherlands Indies, Japan, India, and British Malaya—totaled more than 300 million dollars. American trade with those countries came to more than a billion dollars annually.

Struggle for Power Becomes Sharp

Toward the end of the 19th century, as the United States assumed power in the Pacific, other nations also were bidding for dominance. The struggle was centered at first in China, where vast markets and resources provided tempting opportunities for the industrial nations. The United States, Great Britain, Russia, and France had long contended for economic control in China. A relative newcomer was Japan which, since its opening up to the rest of the world, had sought to solve its problems by expanding abroad.

In 1894 Japan invaded China and swiftly forced the Chinese to accept a humiliating peace giving it large territorial and trade concessions. This action intensified international rivalries and for a time it appeared that China might be divided up among the powers. The United States, to avert this possibility, prevailed upon the nations to accept an "open-door policy," in which each would have equal rights to trade in China.

Japan continued to press its advantage, however, and in 1904 attacked Russia in an effort to remove the threat of Russian control of Korea. A decisive victory established Japan as a leading power in the Pacific at the same time that it eliminated Russia from the first rank of world powers (see Russo-Japanese War). During the first World War, Japan, profiting from the involvement of the European nations, compelled China to accept its "Twenty-one Demands," which further tightened the Japanese hold on China. At the end of the war, Germany was stripped of its possessions and influence in the Far East. This left four major contenders for Pacific power—Great Britain, the United States, Japan, and France.

Washington and London Conferences

To strike a balance of power and thus avert a disastrous naval race, delegates from the four powers met in Washington in 1921–22, along with representatives of five other nations. The major powers agreed to maintain the status quo in the Pacific and to limit their fleets to a scheduled tonnage. All the nations entered into a Nine-Power Treaty guaranteeing China's territorial integrity. (See also Harding, Warren Gamaliel.)

A second treaty was negotiated in London in 1930, in which Great Britain, the United States, and Japan promised to preserve the 5-5-3 ratio for battleships established in 1922. But when this treaty came up for renewal in 1936, Japan withdrew (see Navy).

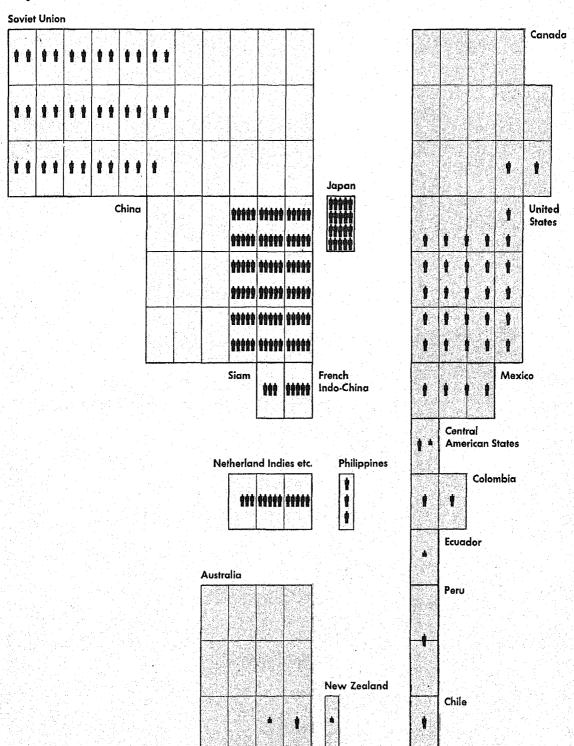
Japan Begins War for Mastery of Pacific

War shadows began to darken the Pacific horizon after 1931, when Japan began a series of aggressive moves to make itself master of China. These soon fell into place as part of a grandiose scheme for the domination of a "Greater East Asia." When a second World War broke out in 1939, Japan had a supreme opportunity to realize this vast ambition.

Allying itself with the Axis powers in September 1940 after the fall of France, Japan, backed by Germany, forced the defeated French government to allow Japanese troops to enter Indo-China. The ABCD powers (Australia, Britain, China, and the Netherlands Indies), alarmed at this threat, began to concert measures of defense. In the summer of 1941 the United States started negotiations with Japan looking to the preservation of peace. While these negotiations were still in progress, Japan struck suddenly and without warning. On Dec. 7, 1941, it attacked American and British defense bases ranging all the way from Honolulu to Singapore. The titanic struggle for mastery of the Pacific was on. (See also China; Japan; World War, Second.)

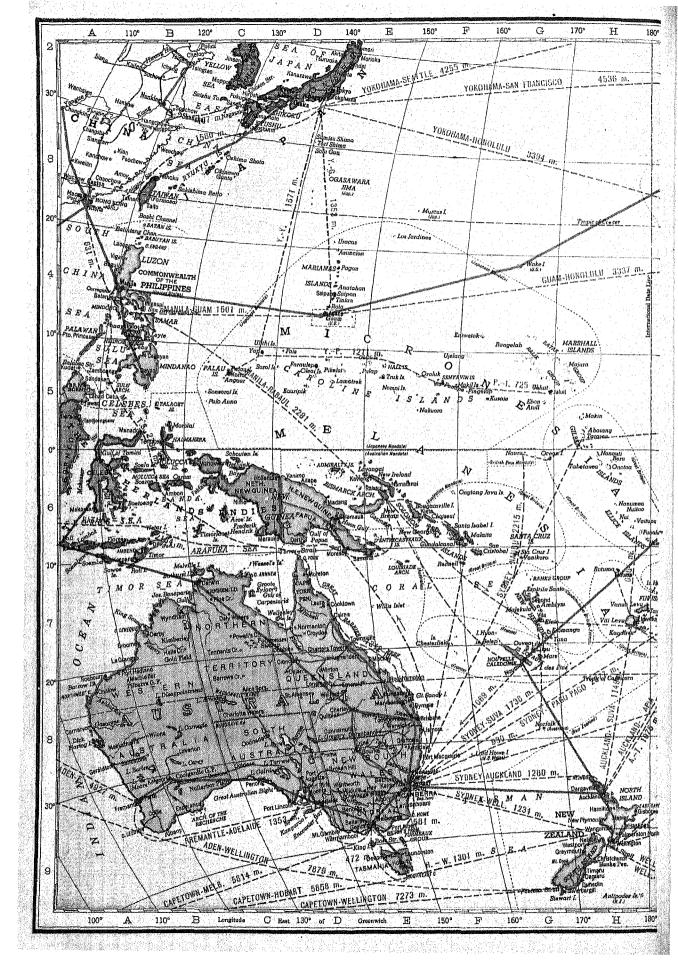
For purposes of naval strategy, the Pacific was divided into three zones. The United States, with its

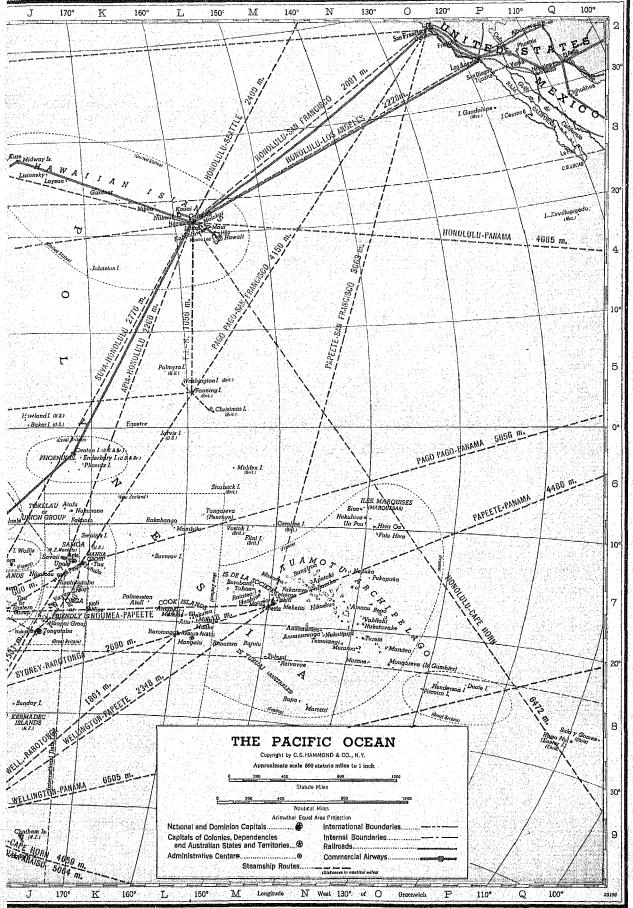
Population and Area around the Pacific Ocean



Each complete rectangle represents 250,000 square miles Each complete man symbol represents 5,000,000 population

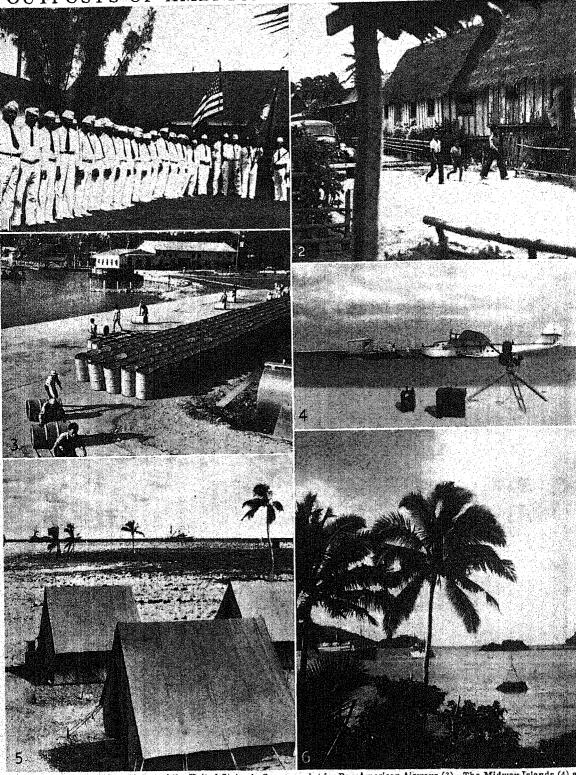
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OUTPOSTS OF AMERICAN DEFENSE IN THE PACIFIC



Farthest west of the defense bases of the United States is Guam, which Japan seized within a week after starting war in December 1941. Turn back to the map and you will see that Guam lies directly south of Tokyo. At the top (1) you see Guam's American Legion, mostly native Chamorros. At the right (2) is a thatchedroof village in Guam. In time of peace, this island is a refueling

point for Pan American Airways (3). The Midway Islands (4) are another refueling point on the long transpacific flight. Canton Island (5) is an air base on the route to Australia and New Zealand, 1,850 miles southwest of Honolulu. It is jointly held by the United States and Great Britain. Pago Pago (6) on Tutuila island, American Samoa, is a vital naval station and air base.

fleet based in Hawaii, was dominant in the eastern Pacific as far south as the Samoan Islands. Great Britain, with its Far Eastern fleet based on Singapore, claimed control of the western Pacific south of the Equator. Japan asserted mastery of the northwestern Pacific. This balance was profoundly altered when Japan launched its attack in 1941 and in a few weeks took Singapore and the East Indies. (See also Pacific Ocean in Fact-Index at end of this volume, and names of individual islands.)

PADEREWSKI (pā-dē-rēf'skī), Ignace Jan (1860–1941). As both musician and statesman, Paderewski's place in history is unique. Ranked with Liszt and Rubinstein as one of the three greatest pianists of all time, he symbolized to the world his native Poland. Hence, during the first and second World Wars, he became chief spokesman for his country and served in its government. His father was a leader in the Polish uprisings of 1863. The terrifying experience

of seeing him torn from their home by Cossacks made a profound impression on the child and was a source of his burning desire to free Poland from its oppressors.

Paderewski was born Nov. 6, 1860, at Kurylowka in southwestern Russia. He began to play the piano at the age of three, but his teachers at the Conservatory of Warsaw, which he entered at the age of 12, thought him more talented as a trombonist. A few years of teaching followed his graduation from the Conservatory, and he acquired some reputation as a composer. It was the Polish actress Helena Modjeska who encouraged him to pursue his studies as a pianist and made it possible for him to

take lessons from the great Polish teacher Theodor Leschetisky in Vienna. His career was launched with concerts in Vienna in 1887 and 1889 and in Paris in 1888.

The first of his many American tours was made in 1891. Paderewski was a great favorite in the United States. Audiences loved him not only for his superb artistry but also for his great shock of red-gold hair, his dramatic manner, and his warm generosity. In February 1941, the fiftieth anniversary of his American debut was celebrated with nation-wide testimonial programs. His own love of America had been expressed in the Paderewski Fund which he endowed in 1897 for prizes to be awarded every three years for the best works by American composers.

When the first World War came, Paderewski's acquaintance with leaders throughout the world made him Poland's best ambassador. He organized an American-Polish legion to fight with the Allies, and he toured the United States and England raising funds for war relief. Returning to Warsaw after the armistice, he became first premier of Poland and its repre-

sentative at the Versailles Peace Conference. He had no taste for practical politics, however, and in December 1919 he retired to his estate Riond-Bosson at Morges, Switzerland.

His generosity had made him poor again and in 1922 he returned to the concert stage. When Poland was again crushed in 1939, he gave the last months of his life to his country's cause. He accepted the presidency of the Polish Parliament in Exile in January 1940 and returned to America to engage in war relief work. He died June 29, 1941, and was buried in Arlington National Cemetery.

Paderewski's compositions include the famous 'Minuet in G'; an opera 'Manru', first produced in 1901; 'Fantaisie Polonaise'; and the 'Symphony in B Minor'. In 1936 he appeared in a moving picture, 'Moonlight Sonata'. His 'Memoirs' were published in 1938.

PAGEANT (pāġ'ant). The elaborate community dramas that we call pageants are an invention of the 20th century. Most of them are dramatic representa-

tions of episodes in the history of a community, appealing to both eye and ear. The story is told in dialogue as well as spectacle, but the chief element is the spectacular. Performances are usually given out of doors, and large numbers of players in costume are used. Sometimes schools, colleges, and other groups present pageants on a smaller scale to celebrate special occasions.

This kind of drama was the creation of the English playwright Louis N. Parker. In 1905 at Sherborne, in England, Parker produced a pageant celebrating the town's 1200th anniversary. From this dates all modern pageantry. The medieval "pageant" meant something very different. It was

the name for the wagon-stages on which the miracleplays were performed (see Miracle-Plays) and did not acquire the meaning of a spectacular procession until later times. Stately parades commemorating religious and historical events have been a feature of civic life in European cities since the Middle Ages. Some American cities have spectacular celebrations of this type, as the Mardi Gras parade of New Orleans, the Festival of the Veiled Prophet in St. Louis, the New Year's Day Mummers' Parade in Philadelphia, and the flower and harvest festivals of many cities.

Soon after its invention, the modern dramatic type of pageant was taken up in the United States. At first, the only type was the pageant of local history, and this still remains the most popular and important variety. But the new dramatic form showed itself to be so vital that it has already given birth to such widely differing types as the masque, the civic festival, and the various school celebrations of such occasions as Christmas, Thanksgiving, Arbor Day, May Day, and the anniversaries of famous men and



PADEREWSKI

DANCING IN

events. Educators have been quick to see the tremendous power of such semi-dramatic productions in focusing interest on social and historical topics, so today one of the familiar features of college and school life is the pageant in its many forms. Often these

productions, from start to finish, are the work of the students; they write the book and the music, and they design and make the costumes and scenery. Examples are the notable productions in 1916 to commemorate the 300th anniversary of Shakespeare's death.

Whether the form be the historical pageant, the allegorical and symbolical masque, the civic festival, or the school play, the basic and essential idea in all is the ex-

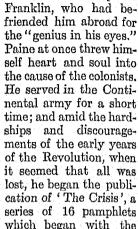
pression of community spirit. As in the pageants and plays of the Middle Ages, the whole community is expected to take part in some way, either as performers, or in assisting in the work of production, or merely as spectators. In the words of William Chauncy Langdon, one of the notable figures in the development of the pageant in the United States. "The modern pageant is an instinctive expression in dramatic form of the new community spirit; and as there never before was such a community spirit in the history of the world, so there never was such an expression of it." This democratic art-form suits especially the character of the people of the United States, where the pageant has developed a depth of meaning, a variety of form, and an artistic completeness such as is found nowhere else.

PAINE, THOMAS (1737–1809). "Freedom has been hunted round the globe. Asia and Africa have long expelled her. Europe regards her like a stranger; and England has given her warning to depart. O, receive the fugitive and prepare in time an asylum for mankind!" This was the clarion call of Thomas Paine to the American colonists, published in his pamphlet "Common Sense" in January 1776—a 50-page argument for independence that was at once hailed by multitudes as their unspoken thought. Thousands of copies were sold. Everybody of importance read it, and as Washington said, it turned the wavering scale of public opinion toward complete freedom from the mother country.

The man who rendered this signal service to the cause of the colonists was a poor English emigrant of Quaker parentage, who had arrived in America only 13 months before. Paine was a born agitator, and so erratic that living with him must have been a trial. After a meager education he wandered from one occupation to another. He went to sea, he tried

manufacturing, and finally he became an exciseman, or collector of internal revenue taxes in England. But he neglected his duties and was dismissed.

Then it was, in 1774, that he came to America, armed with letters of introduction from Benjamin



words. "These are the



A

PAGEANT

Can't you feel the joyous spirit of spring in the very movement of this dance of the "Pipes of Pan" in a pageant of spring given by a group of college girls?

times that try men's souls." This publication put new courage into the colonists. Washington ordered copies of it read to the army, and the opening words quoted above became an inspiring battle-cry.

Paine was rewarded by an official position under the Continental government, but he indiscreetly published information that he had gained in his official capacity and was forced to resign in 1779. After the close of the Revolution, Congress and the states of New York and Pennsylvania granted him money and land, which relieved him from

the pinch of poverty.

He returned to Europe in 1787 with a model of an iron bridge which he had invented, and which was exhibited in Paris and in London. When the French Revolution broke out Paine became one of its English supporters. He wrote an able book called 'The Rights of Man', in reply to an attack on the Revolution published by Edmund Burke. Today Paine's book seems very moderate, but for publishing it he was indicted for treason and fled to France. There he was elected to a seat in the assembly called the Convention. Though he was a radical, Paine was not an extremist, and he opposed the execution of Louis XVI. This won for him the ill-will of the Jacobins, and he was saved from the

ten months in prison he was released.

Paine's inexcusable attack on President Washington, published soon after his release (1796), and his criticism of revealed religion in his notorious 'Age of Reason', lost him many of his old friends. He returned to America in 1802, after the cause of liberty seemed lost in France, but only a few now remembered his services to the cause of the colonies. Suffering from ill health, he wandered from place to place until his death in New York City in 1809.

guillotine only by the fall of Robespierre. After

PAINTING, the QUEEN of the FINE ARTS



'The Unicorns', by Arthur B. Davies, in the Metropolitan Museum of Art, New York City

PAINTING. The history of painting begins in the remote ages when man depended for his existence solely on his skill as a hunter. Among the men of the Old Stone Age, more than 20,000 years ago, there were painters who possessed the adroitness of hand and power of observation that enabled them to paint, with amazing fidelity and spirit, pictures of

bison, horses, deer, and other animals. In the cave of Altamira in northern Spain we can still see their paintings of these animals, in three colors, executed with an assurance of line that would do credit to a modern draftsman. Art expressions of almost equal merit drawn and engraved on bone and ivory have been found in caves of southern France. These carvings and incised drawings show the antelope and the horse, the mammoth and the reindeer.

When man had advanced a little further in culture and learned to domesticate animals and raise crops, these naturalistic drawings disappeared. Perhaps it was because they were of a different race, perhaps because they were no longer dependent entirely upon the skill of hand and eye as hunters, that the men of the New Stone Age seem to have lost their interest and adroitness in drawing. Such rude attempts as we find to represent men and animals in this period were immeasurably inferior to those of the Old Stone Age. There seems to have been no redevelopment of the art of painting until the beginnings of the historic period, when men began to erect elaborate tombs and

FEW strokes of the pencil in the hands of a master, and though we are looking at a flat surface, we see solid forms with length, breadth, and thickness. A few dabs of paint blending in harmony, and we are in the presence of sunlight or shadow; the soft green of a quiet meadow invites, or we are awed by the irrepressible force of the mighty sea; men and women stand before us, and we seem to see into their very souls. Thus the magic art of the painter conjures up forms of truth and beauty. Painting is older than writing; it was employed by primitive man when speech was too crude to express all he wished to say. We shall here make but a brief survey of its development from prehistoric times-of the changes it has undergone, of the possibilities it has revealed, and of some of the great and gifted men who have devoted their lives to this fascinating art.

temples and decorate them with pictures.

The paintings of the ancient Egyptians consisted simply of outlines filled in with flat colors. They knew nothing about the rendering of depth, of light and shade. They tended to conventionalize the human form, drawing it with the shoulders in front view, the head in profile, and the eye full-face. This also was true

of the archaic Greek method. Yet within their limits the Egyptians achieved remarkable success. Men and animals were depicted in characteristic attitudes, often with touches of humor, and every phase of life was shown on the walls of their tombs. In many of their paintings the colors—yellow, red, brown, blue, and green, harmoniously combined with black and white—still remain vivid.

While the art of painting was developing on these lines along the banks of the Nile, it also made considerable progress along the Tigris and Euphrates, where the Babylonians and Assyrians were learning to decorate the interior of their stucco-covered mudbrick walls with painted scenes, while they adorned the exterior with artistic glazed tiles. From the scanty fragments of their work that have survived we can see that they were inferior to the Egyptians in their attempts to represent the human figure, but far surpassed them in the vigor and spirit with which they represented animal figures.

In prehistoric Greece, Crete, and other Aegean lands, about 2,000 years before Christ, artists decorated

vases in rich designs and painted the walls of palaces with animated scenes from the life of the time (see Aegean Civilization). The people who succeeded them, the Greeks of history, sweeping all this away. built up from rude beginnings a greater art of their

own. We can trace an evergrowing feeling for design in the black and red vases that have come down from this time, but their great paintings have disappeared. We can, however, form some idea of their genius from the paintings on the buried walls of Herculaneum and Pompeii. (See Greek and Roman Art; Pompeii.)

Early Christian painting, though influenced by the art of the ancients, shows a decided change in subject and spirit. The followers of the new faith, persecuted by the Roman Empire, sought refuge and a place of

worship in the great underground cemeteries known as the catacombs. They decorated the dark walls with religious symbols and with pictures of Christ and the saints simply and crudely drawn. Later, when they were permitted to worship openly, they built churches and adorned the walls in a similar manner.

Often mosaics took the place of the mural or wall paintings, and many of these more permanent works of art still remain, while the paintings have been destroyed (see Mosaic). Wrought out of tiny bits of marble and glass, they represent the personages of the

sacred narratives as figures of epic grandeur.

With the barbarian invasions and downfall of the Roman Empire in the West there was a general decline of the arts, including painting. Byzantine art, which reached maturity in the 6th century and flourished in the 10th and the 12th centuries, profoundly affected early Christian art and gave an imported conventionalized splendor to the paintings and mosaics of Venice and other Italian cities (see

In the 13th century, at the time that Gothic archi-

Byzantine Empire).

tecture (see Architecture) was flowering in France into "the most beautiful and complex architectural monuments the world has ever known," painting in Italy and elsewhere in Western Europe was taking on a new form, abandoning the stiff conventionalism of the Byzantine and striving for realism—though touched



This vigorous bison was painted on the wall of a cave of Altamira, Spain, by men of the Stone Age, fully 20,000 and perhaps as much as 50,000 years ago. Compare the vitality of the pose and the feeling for anatomy with the Egyptian painting below, a stylized art which concerned itself less with realism than with design and pattern.

AN EGYPTIAN WALL PAINTING MORE THAN THIRTY CENTURIES OLD



A vivid tale of daily life is told in this fragment of a fresco from a Theban tomb, built during the 18th dynasty, which flourished about 1500 B.C. At the right are two charloteers with their horses. In the lower group the horses are feeding while the driver rests. At the left is a man cultivating grain. The original is done in bright red, yellow, and green. The stiff pose was typical of Egyptian art when it was concerned with the tombs of royalty. An Egyptian ruler was regarded as a god, and all art regarding him must be formal, exalted, other-worldly. Such art is interesting for its rhythm and design.

THE EMPRESS THEODORA IN BYZANTINE MOSAIC



Mosaics of bits of colored glass were beautifully made in old Byzantium. This famous mosaic of the Empress Theodora with court ladies and priests was probably brought to Italy soon after it was finished, about the time of Justinian the Great. It now adorns the Church of San Vitale, Ravenna, a splendid example of the rich, formal, oriental, Byzantine art, gorgeous and unreal.

with mysticism—in the handling of religious subjects. Gradually, too, the grace and harmony of Greek and Roman models made itself felt, preparing men's minds for the Renaissance (see Renaissance).

In Italy, Cimabue (died about 1302), of whom so little is known with certainty that he has become a half-legendary figure, paved the way for this great new birth; but it was his pupil, the Florentine Giotto (about 1267–1337), who definitely began the new era in painting. This great master drew his inspiration chiefly from nature, and impressed a whole century with his method of painting "like the life" (see

Giotto). Among those who followed him was the monk of Fiesole (near Florence) called Fra Angelico because of his saintly life. He lacked the variety and breadth and freedom of Giotto, but his saints and angels have a delicate beauty of their own, and the work of no other painter is so filled with Christian devotion.

Arriving at the 15th century in Italy we find the most important epoch in the development of painting. Then it was that perspective, the art of representing objects as they actually appear in space—in three dimensions—was at last mastered (see Perspective). A great advance in truth to nature was made by the study of

anatomy and of the nude form. At this time, too, the technique of oil painting was brought to new heights of perfection.

Before this time Italian painters had produced their great wall paintings for church or palace by working in "fresco," or painting in water-colors on the "fresh" plaster of the wall. As the painting of any particular part had to be completed while the plaster was still wet, the artist was obliged to work rapidly high up on scaffolds and often under great difficulties as to light and position. Fresco painting was the

medium used by Leonardo da Vinci, Michelangelo, and Raphael for their great wall paintings even at the height of the Renaissance. "Tempera" or "distemper," in which the colors were fixed by some medium such as eggs or glue, and a process by which the colors were mixed with melted wax, were also used, especially for altar pieces and easel paintings on wood. Painting in "oil"—that is, with pigment ground in linseed or poppy oil—possesses great advantages over all other techniques and is now generally employed. Its discovery was formerly credited to the brothers Van Eyck of the Netherlands, in the early 15th

GIOTTO DESERTS THE BYZANTINE STYLE



Although still severe and formal, these figures are more lifelike, these faces more individual, than those of the Empress Theodora and her court. They were painted by Giotto, in the Arena Chapel at Padua, and show Christ washing the feet of the Apostles. Giotto was the first painter to free himself from the Byzantine tradition and paint from nature, with human emotion.

century, but we now know that at most they merely made certain technical improvements. At almost the same time the new process spread rapidly in Italy and elsewhere, and gave a great and lasting impetus to the art of painting.

One of the first to point the way towards the representation of the third dimension and of space as a whole was Tommaso Guidi (1402–1429), best known

by his nickname Masaccio, which means "Slovenly Tom" and which was given to him because of the untidiness of his person. His work is full of truth and vigor, and many regard him as the real father of modern painting. Contemporary with and following Masaccio, who died in his 28th year. there was a great company of artists in Flor-Among them ence. were Paolo Uccello (1397-1475), many of whose quaintly realistic pictures were studies in perspective; Fra Filippo Lippi (1406-1469), a monk, not wholly concerned with heavenly things, as we see from his charming but far from devotional paintings; Verrocchio, the teacher of Leonardo da Vinci, and a sculptor as well as a painter; Ghirlandaio (1449-1494), a master of monumental style in fresco; and Sandro Botticelli (1444-1510), who not only treated Christian subjects, but went back to the classic myths, which he paint-

ed with idyllic sentiment and extraordinary grace. Other cities in Italy also raised great painters in this century. At Padua, Mantegna (1431–1506), influenced by the study of classic art, developed a rich and sculpturesque style of painting, which later powerfully influenced the art of Venice, especially through the Bellini brothers, Gentile and Giovanni. Perugia in Umbria produced another line of famous painters, inspired by the gentle beauty of the lovely Umbrian landscape. Chief of these was Pietro Vannucci, who was called Perugino (1446–1524).

In the 16th century Florence gave to the world the two giants of the Renaissance, Leonardo da Vinci and Michelangelo. These two masters, as well as the divine Raphael and the brilliant Venetian colorist Titian, who are counted as the other members of the "quartet of world masters of painting," are treated in separate articles. Andrea del Sarto (1486–1531), called "the faultless painter" by his fellow citizens in Florence.

painted pictures of the Madonna almost as beautiful as those of Raphael, but lacking in spiritual elevation. Antonio Allegri Parma, known as Correggio (1494-1534).was inspired by both DaVinci and Michelangelo, though he was of very different temperament from either. He treated pagan myths and Christian themes alike with soft sensuous beauty and grace. Associated with Titian were Giorgione (1478-1510), noted for his glowing color and magical flesh tints; Tintoretto (1518-1594), who sought to emulate "the drawing of Michelangelo, the coloring of Titian," and was fond of grand effects and violent contrasts in light and shade; and Paul Veronese (1528-1588), whose work perhaps best expresses the splendor of contemporary Venetian life.

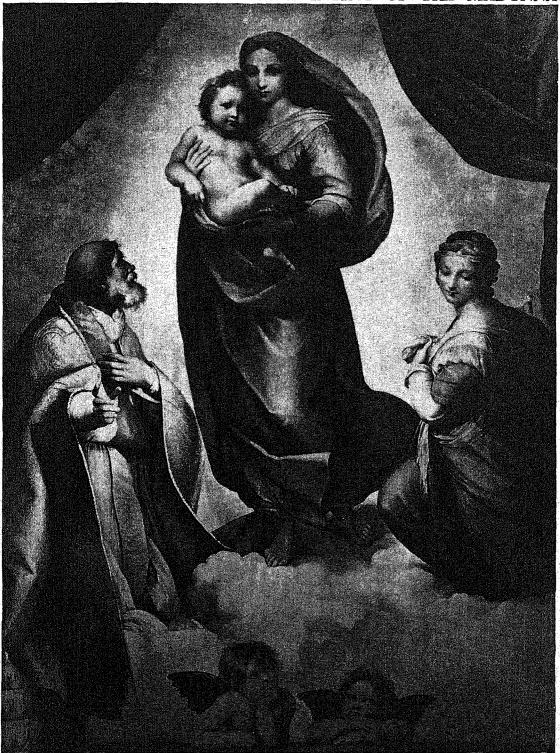
Meanwhile a strong and independent art had been developing in Holland and Flanders. Hubert and Jan Van Eyck headed the Flem-

ish School of the 14th and early 15th centuries. Not only were they great portraitists, but they were the first painters of landscape, replacing the gold background of the medieval panel by a setting of natural scenery, truthfully represented in form and distance. The painters who followed them in Germany often sacrificed beauty in striving for realism in details. But in the first half of the 16th century Germany could boast of two artists, Albrecht Dürer and Hans Holbein, who are among the great geniuses in the history of art. In Flanders Van der Weyden, Memling,



A serious, though graceful, conception of Spring inspired Sandro Botticeili's 'Primavera', a part of which we see above in the stately dance of the Three Graces. It is believed to commemorate the death of Simonetta Vespucci, who died in the spring of 1476. It is in the Uffizi Palace.

THE WORLD'S MOST FAMOUS PAINTING OF THE MADONNA



Talk is hushed when visitors enter the room in the Royal Gallery at Dresden, Germany, where hangs, all alone, this masterpiece of Raphael, the Sistine Madonna. It was painted just before his death and was intended as an altar piece for the Church
of San Sisto at Piacenza. The great canvas has long been considered the greatest madonna painting in the world. The Virgin
is shown less in the character of a mother than as the Queen of Heaven, and she holds a Christ Child whose thoughtful face
reflects a knowledge of his destiny. On either side kneel St. Barbara and St. Sixtus in adoration. The clouds from which the
Virgin descends take the soft shapes of the heads of thousands of cherubs, dimly seen in any photographic reproduction. The
two cherubs at the base have been widely copied, and would alone have brought fame to any painter.

and Quentin Matsys continued the realistic style of the Van Eycks, but the next generation of Flemish painters studied in Italy and imported the Italian methods. As a whole these so-called "Italianizers" failed to produce great art, but out of their ranks came the mighty Rubens, who, without losing his own individuality, brought into his work the richness and fullness of Venetian art.

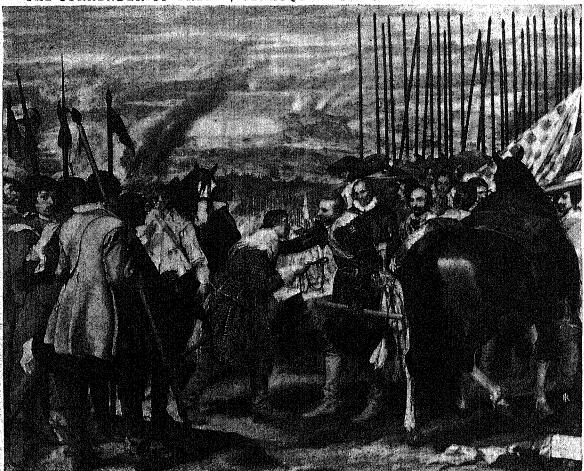
In the 17th century in Holland and Flanders, the "Dutch Little Masters," as they are called, gave to painting a new democratic expression. They raised genre, or the painting of common life, to the level of great art. Beauty, they had learned, may be found anywhere: in the courts of kings, the sordid market corner, the meadow, or the barnyard.

This kind of painting, which is much like a photograph in the exactness of its representation, is interesting and charming but it is not the highest expression of the artistic instinct. The great Rembrandt (1606–1669), whose portraits and landscapes are now almost priceless, put into practise a principle, which may be

stated briefly thus: The impression which a face or a scene makes is more important than the details of reality; in other words, details should be subordinated to the impression of the whole picture. The establishment of this vital principle of modern painting owed much to the earlier work of the Cretan-Spanish artist El Greco (Domenico Theotocopuli, 1542?–1614), who had distorted color and line to transfer to canvas the dramatic and passionate mysticism of his conceptions. It rules the work of Rembrandt's powerful contemporary in Spain, Velasquez (1599–1660).

Ranking not far below Rembrandt as portrait painters were the jovial Frans Hals (1580?–1666) of Haarlem and Van Dyck (1599–1641) of Antwerp. The latter founded the English School of portrait painting, and left an unsurpassed gallery of historical portraits. Vermeer (1632–1675), of Delft, and Jan Steen (1626–1679) are among other noted masters of the Dutch School. In Spain, Velasquez was followed by Murillo (1617–1682), a charming painter, and always a great favorite. In the 18th century, Spanish painting flamed

'THE SURRENDER OF BREDA', VELASQUEZ' GREAT HISTORICAL PAINTING



Velasquez painted but few historical pictures. 'The Surrender of Breda', also called 'Las Lanzas' (The Lances), is an exception. It shows the Marquis of Spinola, famous Spanish general, receiving the surrender of General Nassau, defender of the Dutch town of Breda, June 5, 1625. Note how straight and triumphant are the lances of the Spanish troops, how wavering and lost the axes and pennants of the conquered Dutch. Velasquez painted Spinola's face from memory. The picture is in the Prado Gallery, Madrid.

STUDIES IN YOUTH AND MATURITY BY GREAT MASTERS



These five Syndics of Cloth Hall, with their servant, the hatless figure, were painted in 1661 by Rembrandt for the Gild of Drapers in Amsterdam. It hangs now in the Rijks Museum, Amsterdam. The serene and honest faces, glowing in Rembrandt's own magical light, contrast beautifully with their black garments, the yellow-brown woodwork, and the deep scarlet table cover.





Famous painter of childhood, Sir Joshua Reynolds delighted the world with 'The Age of Innocence', probably a portrait of his little niece, Theophila Palmer, whom he called "Offy." How she fairly gleams against her dusky landscape background! Stiffer little people are Prince William II of Orange and his betrothed, Princess Mary Stuart, by Sir Anthony Van Dyck, in Amsterdam.

LANDSCAPE PAINTING-A COMPARATIVELY RECENT ART



Landscape, which earlier painters used simply as a background for figures, became in later years a subject in itself. A spacious outdoor charm attracts us in the famous 'The Avenue, Middelharnis', by Meindert Hobbema, in the National Gallery, London.



When a crific said to J. M. W. Turner that he had never seen a landscape like one of his, Turner replied, "But don't you wish you might see one like that?" The above is the Grand Canal in Venice. It hangs in the National Gallery, London.

THE WIT OF HOGARTH IN 'MARRIAGE À LA MODE'



In his masterpiece, 'Marriage à la Mode', the satirical English painter, William Hogarth, portrayed in several scenes the tragic end of a mismated viscount and his bourgeoise bride. Here we see an unedifying assembly in the countess' dressing-room. All Hogarth's pictures reflect the lusty, uncouth life of his day. This picture, dated 1745, now hangs in the National Gallery, London.

brightly again in Goya (1746–1828), a master of characterization who vigorously satirized the corruption of politics and society in his day. In this field he has but a single peer, the English Hogarth (1697–1764). At the same time, in Italy, Tiepolo (1692–1769) made himself almost the equal of Veronese in decorative painting; and for sparkling vivacity of color he stands unsurpassed even now.

In the 18th century France produced one supreme painter, Watteau (1684–1721). Often his work is passed by as merely representing the magnificence and empty pomp of the court of Louis XIV; but even if his subject matter is frequently trivial, his supreme mastery of exquisite color harmonies assures him a permanent place among the greatest painters.

Landscape Painting as an Art

Landscape painting as we know it came into being in the 17th century. Earlier artists had regarded it as incidental to the figures and to the story of the picture, or as the setting for action; now it became the picture, an end in and for itself. The Dutch painters, Ruysdael (16287–1682), Hobbema (1638–1709), and Cuyp (1620–1691) were among the earliest to show how a faithful representation of actual scenes

might reach a high level of artistic expression. They fell far below Rembrandt's supreme attainment though, because they did not realize (as Rembrandt never failed to do) that "landscape implies a state of mind," and that the revelation of such a state of mind upon canvas is the only truly poetic element in landscape painting. France at about the same time gave rise to what is known as "classical landscape" in the work of Nicolas Poussin (1594–1665) and Claude Lorrain (1600–1682). This type of landscape, no matter how artificial in its arrangements, is still genuinely creative in so far as it deals with the spirit of a scene, the spirit of nature, and not its material forms only.

England in the 18th century took a high place in the world of painting. Hogarth who was the first characteristically English artist, remains probably the greatest of satirists in painting, with the exception of the Frenchman Daumier (1808–1879). 'Marriage à la Mode', 'Rake's Progress', and others of his "continued stories" in a series of canvases teach moral lessons in compositions of great artistic charm. Charles Lamb said, "You look at other pictures, but read Hogarth's." This is true, but it does not take into

MILLET, THE PORTRAYER OF HUMBLE PEASANT LIFE



No more commonplace theme could be found for a painter than that of 'Bringing Home the Newborn Calf' by Millet. Scorned because he did not paint pretty ladies and elegant court scenes, Millet lived in poverty that he might paint the lives of simple French peasants. Here he has caught the soft twilight air, peasant stolidity, and the anxiety of the dumb mother.

account Hogarth's chief greatness as a painter—his masterly use of color. It is easy to tell a moral tale in pictures—many men have done so—but very rarely is it told in terms of great beauty.

Sir Joshua Reynolds (1723–1792), who is unrivaled in painting the charm of childhood, with equal ability did glorious portraits of many of the social and political celebrities of his day. With him stand Gainsborough (1727–1788) and Romney (1734–1802), the artistic successors of Van Dyck,

The Influence of Turner

Two great English landscape painters, Constable (1776–1837), who used bright natural colors instead of the characteristic browns and greens of Dutch landscapes, and J. M. W. Turner (1775–1851), "the greatest magician of light who ever wielded a brush," bring us into the full swing of painting in the 19th century. "If you are going to see Constable's pictures take an umbrella," was an often repeated witticism of the period, because of the realistic power exhibited in his pictures of storms. Constable's success as a "naturalist" influenced the French artists and so had a part in creating the so-called "Barbizon group," or "the school of 1830," in France.

To Barbizon, a village in the forest of Fontainebleau near Paris, Theodore Rousseau (1812–1867) retired to live close to nature. After him came Millet, Corot, Daubigny, Diaz, Dupré, and others. Their aim is expressed in the words of Rousseau: "Let us try in our works to make the manifestation of life our first thought; let us make a man breathe, a tree live."

This period in France also produced gifted animal painters, Troyon and Rosa Bonheur, the successors of the Dutch Paul Potter and Cuyp, and the equals of Landseer in England. (See Bonheur; Corot; Millet.)

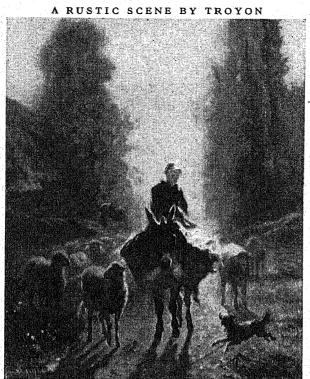
In England, during the first half of the 19th century, water-color painting took a place with oil painting as a medium of artistic expression, largely through the work of Turner. This was a happy occurrence for art, because water-colors easily lend themselves to bringing out the most delicate shades of feeling. Turner worked long and faithfully with water-color and left hundreds upon hundreds of pictures in it, many of which are even superior to his world-famous oil paintings.

Birth of the Pre-Raphaelite School

Shortly before 1850, came the Pre-Raphaelite movement in art and literature. In art, its strength is in

the delicacy and loveliness of its details; its inspiration was largely due to Ford Madox Brown, although Brown did not associate himself with the "Pre-Raphaelite Brotherhood," formed in 1848 by the youthful painters Dante Gabriel Rossetti, Holman Hunt, and Millais. "Let us get back to life again," was their motto. "Let us have something to say; let us shirk no detail; let us be sincere." They aimed to attain the "directness, honesty, and inspiration which they discerned in the painters before Raphael." Their scrupulous fidelity to detail is illustrated by the story that Hunt went to the Holy Land to obtain local color for his picture 'The Shadow of the Cross', in which Jesus is shown at work

in his home as a carpenter. When the painting was completed, a friend in England suggested that the shavings on the floor were from the wrong kind of tree. Thereupon, Hunt went to Palestine again to make certain that he had represented the sort of cedar wood on which Jesus would have worked.



A great colorist and animal painter was Constant Troyon, whose 'Going to Market', in the Metropolitan Museum of Art, is full of early morning freshness, dog gaiety, and donkey meekness.

THE PRE-RAPHAELITES ABANDON ACADEMIC RULES

Sir Edward Burne-Jones (1833-1898), a pupil of Rossetti, was associated with this group; and G. F. Watts (1817-1904), famous for his portraits of Tennyson and Browning and his beautiful allegorical pictures, was inspired by a similar feeling. Lord Frederick Leighton (1830-1896) and Sir Lawrence Alma-Tadema (1836-1912), chose ancient Greek subjects, which they treated with archeological accuracy of detail and technical perfection of workmanship. Leighton's doctrine was that "the chief task of art is to reveal the inmost springs of beauty

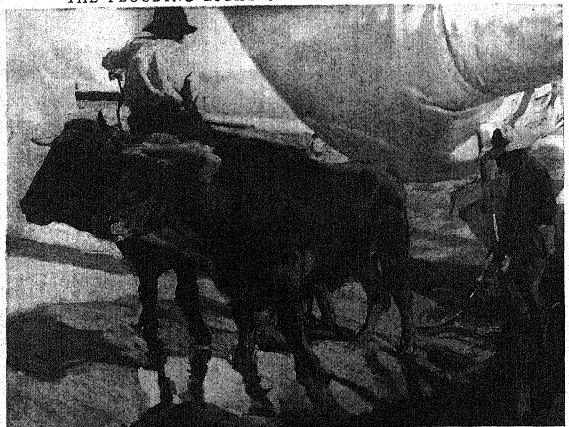
in the created world." The French Impressionists

About 1860, in France, a group of painters rebelled against classical traditions and struck out

along a new line. The name "impressionists," which soon attached itself to this school, indicates the fundamental purpose of its followers—to paint the immediate impression an artist receives from objects in nature. The impressionists aimed especially to render truthfully the effects of light by using only the pure

The Pre-Raphaelites in England sought to abandon the academic conventions and false classicism of the early 10th century and return to the artistic freedom of the painters before Raphael. 'The Mill', above, by Sir Edward Burne-Jones, is typical.

THE FLOODING LIGHT OF THE LUMINIST SCHOOL



Strongly influenced by impressionism, the Spanish painter, Sorolla, headed the Valencian Luminist School to which belonged most of the artists of eastern Spain. Light pours over the canvases of Sorolla, the strong, vivacious sunlight of Spanish skies. We see one of Sorolla's most brilliant effects in 'Hitching Oxen to the Boat'. The impressionistic note is strong in the broad treatment which completely rejects photographic detail and emphasizes that essential first impression of objects on the eye.

colors of the spectrum. They avoided sharp outlines and excluded all unnecessary detail. As a result, their pictures seem, at close hand, mere rough patches of colors; they must be viewed from a distance to give the desired effect. Their work was at first ridiculed; but the art of today, throughout its whole range, shows traces of impressionist influence. This school was founded by Edouard Manet (1832–1883), and his chief followers were Claude Monet, Degas, Pissaro, and Renoir. In England James McNeill Whistler (1834–1903) was strongly influenced by impressionism. In Spain it won over two of the greatest of modern painters—Sorolla and Zuloaga.

Recent Revolutionary Movements

Out of the impressionist movement was born shortly before the World War the still more revolutionary "post-impressionism," which represents a violent reaction against all older theories and practises. Followers of this school no longer attempt to paint nature, but seek to express feeling through form and color. As Roger Fry, one of the important English painters associated with the movement says:

The post-impressionists do not seek to paint form but to create form; not to imitate life but to find an equivalent for

life. They wish to make images which, by the clearness of the logical structure and by their closely knit unity of texture, shall appeal to our disinterested and contemplative imagination with the same vividness that the things of actual life appeal to our practical activities.

One group of these radicals, who call themselves "cubists," obtain their effects by painting only in geometrical forms and lines. Another group, the "futurists," make intensity and force their primary aims. Whatever the significance and value of these daring experiments may be, some really impressive paintings have been produced in these later styles, especially by certain English war artists who used the cubist formula to portray bodies of troops in action. Some of the most radical painters in the new style violently distorted facts for the sake of expressing power. All these innovators surprised, and sometimes horrified, conservative lovers of art, who held firmly the principle that recognizability is the sole aim of art; or, as the French painter Gustave Courbet said, that "nothing at all should be invented—only things actually seen should be painted." The great names associated with these revolutionary movements in painting are Cézanne, Gauguin, and Van Gogh. Their chief inspiration for pure, vital, disembodied power

WHISTLER AND MONET DEFY THE CLASSIC CONVENTIONS



A gem of color and lighting is Whistler's 'At the Piano', which shows his sister, Lady Haden, in black, her little daughter, Annie, in white, with a red rug and table cover, a Chinese bowl in blue and gold, and a background of gray, green, and gold.



Many impressionistic pictures must be seen from the proper distance, and in their true colors, to be properly judged. Monet's 'La Grenouillère', full of gay sunlight and motion, is of this type. The "dabs of paint" are peculiar to his style of painting.

PORTRAITS BY NOTED FRENCH MODERNISTS





A return to primitive simplicity and symmetry of pose was a feature of the portrait work of Paul Cézanne, who was influenced by, rather than permanently associated with, the impressionists. There is strength and insight in 'The Boy with the Red Vest', at left. Character speaks also in Vincent Van Gogh's 'L'Arlésienne', showing Mme. Ginoux, a woman of Arles, in Arlesian costume.

was in the work of the old Spaniard El Greco, and Giotto, the father of Italian painting, who was superb in his simplicity.

Revolt Against Copyists

In a word, the whole modern trend in painting has been a concerted movement against pictures which seek to vie with photographs, like those of Bouguereau in France and Church in America; to create, not to do color photography. It can all be included under the single term "modernism." As time advanced it took different forms in different countries, but the original impulse came from Paris, the art capital of the world. From Paris, influences sweeping outward in every direction have inspired and vitalized all who can understand. These influences have also ruined the weaker-always the greater number-who can do no more than blindly try to follow a movement which they do not understand. The principle of modernism was in Whistler's mind when he inveighed eloquently against "purposeless copying, without thought, each blade of grass." He believed that the true artist

studies the long curve of the narrow leaf, corrected by the straight tall stem, and from it "learns how grace is wedded to dignity, how strength enhances sweetness, that elegance shall be the result." Americans may always remember with pride that it was the American Whistler that wrote the great treatise on art, 'The Ten o'Clock Address', from which these words are taken. It is the greatest utterance on the theory of modernism yet delivered; and its author, one of the truly great painters of all time, was hooted and ridiculed, like his brothers of more radical tendencies today. The idea that a picture is, and must be, a recognizable copy of something which actually exists in nature, is still powerfully entrenched.

The Frenchman Derain is the acknowledged head of the present generation of modernists, along with Matisse and Picasso, his elders by a few years. Augustus John and Duncan Grant are the leaders in England. America too has produced many good modernists, among them George Bellows, Arthur B. Davies, and Rockwell Kent.

Painters of the United States

THE United States, as yet, has not a distinctive native art. It has, however, produced many painters whose names will live. American painting had its beginning with a number of portrait painters of varying ability. Benjamin West (1738-1820), in the light of present standards, is not a great artist, but he

encouraged the founding of the Royal Academy in London in 1767 and later became its president. West passed his boyhood in Philadelphia, when the Indians lived just on the outskirts of that city, and they gave him the material he used for 'The Death of General Wolfe'. He painted a large number of historical and

religious pictures. One of his best-known paintings is 'Death on the White Horse', in the Pennsylvania Academy of Fine Arts in Philadelphia. Although West was an American by birth, most of his life was passed in England.

John Singleton Copley (1737-1815) was another distinguished portrait painter of the time. Charles Willson Peale (1741-1827), whose portrait of Washington is probably his best work, and John Trumbull (1756-1843), famous for his 'Battle of Bunker Hill'

and 'Signing of the Declaration of Independence', won distinction in the times preceding the Revolution and the early days of the new republic. GilbertStuart (1755-1828) is chiefly remembered for his 'Athenaeum Portrait of Washington', the best known and most popular of all the pictures of Washington. It is in the Museum of Fine Arts, Boston. Thomas Sully (1783-1872) was born in England, but as most of his life was passed in America, he has been classed with the Americans. His portraits were of uneven quality, yet there are some of surprising beauty.

The Hudson River School

Early in the 19th century, America developed a group of painters known as the "Hudson River School," of which

Thomas Cole (1801-1848) was a leader. He found the beauty of American landscape for many who had never before discovered it. Turner said of him, "He is as much a poet as a painter." Thomas Doughty, Frederick E. Church, and Emanuel Leutze, who painted the well-known picture of 'Washington Crossing the Delaware', are other names connected with the Hudson River School, which came nearer to being a distinctly national school than any other America has known. Since its day, American painting has gone rapidly towards the cosmopolitanism which at present prevails. Yet there have always been exceptions. One such was William Morris Hunt (1824-1879), who studied under the great French artist, Millet. Hunt brought the ideas of the Barbizon School to America. As a result a romantic grace, clearly seen in his own work in landscape and homely figures, redeemed innumerable paintings which otherwise would be utterly commonplace. George Fuller (1822-1884) also won distinction in this kind of work.

America's Landscape Painters

George Inness (1825-1894) was America's first great landscape painter and many consider him to be one of the world's great painters. It has been said of him: "The power of touching the mystery of familiar things was one of Inness' strong points. There lingers in and around his landscapes that human warmth

which makes the world akin." Inness caught the passing moods of scenes in nature and fixed them in compositions of wonderfully harmonious arrangement, color, light, and shade. His'Rosy Morn' has been called a benediction of light.

Among other distinguished American landscape painters of the later 19th century were Homer Martin (1836-1897), who was gifted with the ability to express much through a few simple details. and Alexander H. Wyant (1836-1892). who painted most of his delicately beautiful hand after he had lost the use of his right. Winslow Homer (1836-1910) stood alone as a of seamen and fisher-

Elihu Vedder (1836–1923), figure painter, pictures with his left painter of the sea and

folk. The incalculable weight of water and force of motion in a great wave mounting to its crest, or breaking upon the everlasting hardness of a granite shore, are depicted by this man as by no other.

John La Farge (1835-1910), an artist of vision and influence, is best known as a mural painter, as are Edwin Blashfield, Kenyon Cox, and Edwin Abbey, the last well known for his graceful murals in the Boston Public Library. La Farge is to be remembered as the nation's most distinguished stained-glass artist. He was a consummate craftsman. He had a zest for beautiful technique, for executing splendidly, as well as expressing great ideas.

Whistler's Influence on Art

Whistler might be considered the greatest genius in the history of American art, though he passed most of his life abroad. The public laughed at his eccen-



The whole story of a race is told in the sullen face of this Indian girl, painted in all her primitive stolidity by Robert Henri. This American painter was noted for his skill at making the character of his subject flash forth, whether an Indian, gipsy, or Irish lad.

FINE LIGHTING BY TWO FAMOUS AMERICAN PAINTERS OF LAND AND SEA



An autumnal riot of color, a rich piling up of bright reds and sparkling blues and gorgeous yellows, warms the landscape 'Autumn Oaks', by George Inness, great American landscape painter. The oaks flame out in red, with a green tree in the foreground and a gay golden hickory at the side. Beautifully transparent are the shadows, not mere opaque blotches of darkness, and all tones are subtly blended in the famous Inness manner. The picture now hangs in the Metropolitan Museum of Art, New York.



Horror is never more intense than in a beautiful, brilliant setting. Winslow Homer's 'Gulf Stream' gives tragedy this ironical touch when he shows us the wrecked sailing ship, its mast snapped off short, with the hapless negro in despair on deck. On the horizon a ship has falled to see his distress. He gazes with terror at the oncoming waterspout which will cast him into the jaws of the sharks all about him. Over the terrible scene plays golden sunlight, sparkling on the vivid blue transparent waters. This is one of many pictures which resulted from the artist's visit to the Bahamas. It is now in the Metropolitan Museum.

tricities and his theories of art, but his work has come of late to be accepted as of the first order. Whistler was among the first to recognize the remarkable beauty of Japanese color prints; and it was from them, just discovered by the Western World in the 1850's, that he learned hitherto unsuspected facts about color harmony. new appreciation of oriental art has done much to change the complexion of Western art and

John Singer Sargent was born abroad of American parents and, like Whistler, spent most of his life in Europe; but his influence on American portrait painting was great. His best-known work

Western taste.

is his 'Frieze of the Prophets', on the walls of the Boston Public Library. William M. Chase is another distinctive American portrait painter. His paintings of his daughters, 'Alice', and 'Dorothy' are of unforgettable beauty. John W. Alexander executed many fine portraits, as well as paintings of such fanciful and poetical subjects as 'The Pot of Basil'. Gari Melchers, one of the most virile and distinctive artists of his day, was a sympathetic painter of sturdy peasant types. His 'Marriage' in the Minneapolis Institute of Arts is nobly direct in its treatment.

Ralph Blakelock and Albert P. Ryder, alike in their aloofness from their fellow men, were alike too in their power to penetrate to the poetic heart of a landscape and to express it: Blakelock in the solemn glow of an autumn evening; Ryder in an unreal light—almost the "light that never was on land or sea." They were both, in fact, poetic painters of the highest rank, but their range was limited. Not so the sympathies of Arthur B. Davies, whose poetic inspiration in depicting landscape and figures was as great as that of any

AMERICA'S GREAT PORTRAIT PAINTER



No painter ever put more smartness and elegance into his pictures than did the American, John Singer Sargent. This portrait is commonly called 'The Three Graces' and is of the Wyndham sisters.

'THE POT OF BASIL'



A poetic feeling lingers in 'The Pot of Basil', by John W. Alexander.

other man. "Never once does he wander from his dream, his vision," says a critic. He is whimsical, vaguely allegorical, never commonplace or sentimental. He is a true mystic in thought, and a lyricist in utterance. So compelling are his rhythms of line, mass, color, and light, that it has been said, one almost hears them. 'The Unicorns'. 'Night Overture', and 'Tiptoeing Youth' are characteristic pictures by Davies.

E. W. Redfield and Gardner Symons are realists who paint nature with forcefulness and truth; and Paul Dougherty is a master of seascape, and rocks and waves and sky—the rightful successor to Winslow Homer.

American artists have painted the beauties of the natural landscape, but Jonas Lie in his New York and Panama Canal pictures has perhaps best depicted the power of man to overcome great natural obstacles. Robert Henri, George Bellows, and George Luks have shown other aspects of modern life. The vanishing life of the Western cowbov is fixed in the paintings of Frederic Remington. E. Irving Couse tells the story of the Indian. Rockwell Kent has gone to remote places, Alaska and the far South, and brought them to us through such convincing paintings that we must believe them whether we like them or not. elemental in nature is his passion; the trivial his scorn. (See also Drawing; Fine Arts.)

One of the most interesting developments of painting in the New World has occurred in Mexico, where a genuine Mexican culture has slowly grown up from the contact of Spaniard and Indian. During the present century the Mexicans have been producing many fine frescoes, oils, and water colors which have attracted world-wide attention. The style is

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bold, novel, and imaginative, not unlike the work of the French "moderns." The Mexican public schools have obtained remarkable results from the attention given to the study of art. Something fresh and authentic animates the sketches and paintings of burro and peasant, adobe house and cactus, turned out by the young Mexicans.

All such early study of fine paintings awakens an understanding and taste for good art which warms and deepens the whole life of the individual. To learn to enjoy in a painting the light of a spring morning, the tousled roughness of sheep, the springing line of trees or the character in a strong face, is to have deeper joy and knowledge of such things as seen in life.

This discussion, which of necessity must leave out so many more names than it includes and which can but suggest the way for the student, may well end with the words of Duncan Phillips: "How poor a business is partisan abuse of any kind of art in a world where each sort of mind has a full right to its own due expression! He is a poor philosopher who holds a view so narrow as to exclude forms not to his personal taste. What is Art but the perfected expression of self . . .? Whether that self be of enlightening or fairy telling temperament is of no moment whatsoever. Of all kinds of energy, Art is surely the most free, the least parochial; and demands of us an essential tolerance of all its forms."

-REFERENCE-OUTLINE for PAINTING and ALLIED ARTS-

AS OLD as the race itself is the impulse to give expression to emotion and the sense of beauty. Long before men learned to write, they were striving to record in concrete form their faiths and fears, their ideals and hopes. As civilization advanced painting developed, finding characteristic expression in the various countries and periods so that the study of painting and other graphic arts, apart from the pleasure it gives us and apart from its effect upon our emotional development, has a great historical value. Their history is really the history of manners and customs of peoples, and a vivid narrative of the development of ideas and ideals.

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Bibliography for Painting -Books for Younger Readers:

Barstow, C. L. Famous Pictures (Appleton-Century, 1930).

Berry, A. M. Art for Children (Studio, 1934).
Blake, Vernon. Drawing for Children and Others (Oxford, 1927).
Bryant, L. M. Children's Book of Celebrated Pictures (Appleton-

Century, 1922).
Chandler, A. M. Treasure Trails in Art (Hale, 1937).

Doust, L. A. Simple Sketching (Warne, 1933). Furniss, Dorothy. Drawing for Beginners (Bridgman, 1928).

Hillyer, V. M. and Huey, E. G. A Child's History of Art (Appleton-Century, 1933).

Holme, Geoffrey. Children's Art Book (Studio, 1937). Irwin, Grace. Trail-Blazers of American Art (Harper, 1930). Lester, K. M. Great Pictures and Their Stories, 8v. (Mentzer, 1927). Thach, S. D. Finger Painting as a Hobby (Harper, 1937).

-Books for Advanced Students and Teachers:

Materials and Methods

Bye, A. E. Pots and Pans; or Studies in Still-Life Painting (Princeton Univ. Press, 1921).

Chase, J. C. An Artist Talks about Color (Wiley, 1930). Doerner, Max. Materials of the Artist and Their Use in Painting

(Harcourt, 1934). Rich, A. W. Water Color Painting (Lippincott, 1918).

Stokes, Adrian. Landscape Painting (Lippincott, 1925). History and Appreciation

Abbot, E. R. Great Painters; in Relation to the European Tradition

(Harcourt, 1927). Bailey, A. E. The Gospel in Art (Pilgrim Press, 1931). Binyon, Lawrence. Painting in the Far East (Longmans, 1934). Brooks, A. M. From Holbein to Whistler (Yale Univ. Press, 1920). Caffin, C. H. How to Study Pictures (Appleton-Century, 1941). Craven, Thomas. Men of Art (Simon & Schuster, 1931).

Craven, Thomas, ed. A Treasury of Art Masterpieces (Simon &

Schuster, 1939).
Fry, R. E. Flemish Art; a Critical Survey (Coward, 1927).
Gardner, Helen. Art through the Ages (Harcourt, 1936).
Johnson, Charles. English Painting from the Seventh Century to

the Present Day (Dial Press, 1932).

Mather, F. J. History of Italian Painting (Holt, 1923). Orpen, Sir William, ed. Outline of Art (Putnam, 1938)

Underwood, E. G. Short History of French Painting (Oxford, 1931). Van Dyke, J. C. How to Judge of a Picture (Abingdon Press, 1889).

Modern Painting

Bulliet, C. J. Significant Moderns and Their Pictures (Covici, 1936). Earp, T. W. Modern Movement in Painting (Studio, 1935). Pach, Walter. Masters of Modern Art (Viking Press, 1924). Wilenski, R. H. Modern French Painters (Reynal, 1940). Wright, W. H. Modern Painting; Its Tendency and Meaning (Dodd, American Painting

Boswell, Peyton. Modern American Painting (Dodd, 1939). Caffin, C. H. Story of American Painting (Stokes, 1907). Cabill, H. and Barr, A. H., eds. Art in America (Reynal, 1934). Cheney, M. C. Modern Art in America (McGraw, 1939). Hagen, O. F. L. Birth of the American Tradition in Art (Scribner,

Helm, MacKinley. Modern Mexican Painters (Harper, 1941) Isham, Samuel. History of American Painting (Macmillan, 1927) La Foliette, Suzanne. Art in America (Harper, 1929).

PAINT-What IT IS and Where WE GET IT

PAINTS AND VARNISHES. The last 50 or 60 years have brought the manufacture and use of paints and varnishes from a "rule-of-thumb" art to an exact and expanding science. The use of paint both for protection and beauty can be traced back to ancient Egyptian times. There even is some evidence that these first paints contained ingredients essential to many of our paints today. What modern chemistry has done is to show us exactly why these ingredients are necessary and to increase enormously the variety of materials available for paint making. We have today different paints for almost every kind of surface and protective purpose.

The functions of ordinary paints are to cover up or decorate surfaces, to preserve them from wear or decay, to make them easier to keep clean and therefore more sanitary, and to increase or diminish the light reflected from them. But, in addition to the ordinary paints we see around us on houses, interior walls, furniture, and automobiles, we have paints to stop corrosion, paints that are fireproof or waterproof, luminous paints which glow in the dark, and poison

paints to ward off parasites.

How Oil Paints Are Made

Two types of paints are commonly used—oil paints and water paints. The oil paints are the most important and will be discussed first. To prepare oil paints, four types of materials are mixed together: (1) pigments for color and opacity; (2) vehicles to hold and bind together the pigment particles and to act as adhesives by which the paints cling to surfaces; (3) driers to regulate the drying time; (4) thinners to make the paints spread and penetrate. It is essential that the pigments do not dissolve in the paint liquids; if they did, the solution would be transparent like a dye or a stain.

Body pigments are usually white substances used to make the paint opaque. The best known is "white lead" (basic lead carbonate). Lithopone (barium sulphate plus zinc sulphide plus zinc oxide), another well-known body pigment, tends to discolor in the sun and is therefore used almost solely for interior paints. Because of its brilliant whiteness, zinc white (zinc oxide) is often mixed with white lead. Where great covering action is desired, titanium white (titanium oxide) is an excellent body pigment, having two or three times the opacity of white lead. It is commonly mixed with barium sulphate and zinc oxide to improve its durability.

Certain other pigments such as whiting (calcium carbonate) or barytes (barium sulphate) are called extender pigments, and in small quantities add to the durability of paints. In large quantities, however, they greatly diminish the covering qualities and are considered adulterants of oil paints.

To produce desired colors, one of the body pigments is supplemented with a color pigment in the form of an oil paste. Thus, to get a black paint we add carbon black or lampblack; for a blue we may add Prussian blue (ferric ferrocyanide) or cobalt blue (cobalt aluminate); and for a red, ferric oxide or vermilion (mercuric sulphide). Yellows may be produced with chrome yellows (lead chromates), ochre (limonite), or various compounds of zinc, arsenic, or cadmium. Green pigments include chrome green (chromium sesquioxide), copper greens like malachite, and mixtures of blue and yellow pigments.

Paints for Special Purposes

Metallic pigments, called "bronzes" in the paint trade, are formed from powdered aluminum, copper, brass, or bronze. They give the paint a silvery or golden luster. Paints made in this way have good reflecting power and protect surfaces from the effects of light and heat.

Asbestos, borax, powdered glass, and other retarders of fire are added to the usual formulas to make fireproof paints. Sulphides of barium, strontium, or calcium make luminous paint. An extremely small amount of a radioactive substance has the power to make zinc sulphide glow in the dark, and this treated substance is used for luminous watch and clock dials. Copper or mercury oxides added to paints protect ship bottoms from the attacks of marine parasites.

Making White Lead and Other Body Pigments

The white lead base for paints is produced by several processes. In the "Old Dutch" process, melted lead is put into shallow molds to make flat grates or "buckles." These are packed in earthenware pots with half a pint of vinegar or acetic acid in the bottom. The pots are left about 130 days in tiers between layers of spent bark. The fermenting bark generates heat and gives off carbonic acid gas; this gas vaporizes the acetic acid, which attacks the lead, coating the buckles with basic lead acetate. This in turn is attacked by the carbonic acid and changed to basic lead carbonate, or white lead.

In the "quick" or "Carter" process, granulated lead diluted with acetic acid is put in slowly revolving drums and subjected to the action of purified carbonic acid gas. The chemical action that occurs is similar to that in the Dutch process. White lead is also made by

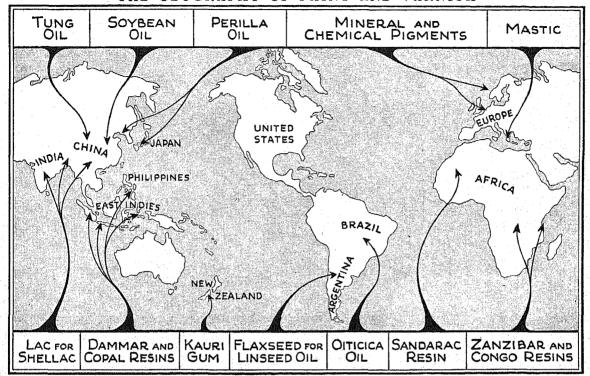
electrolysis (see Electrolysis).

Zinc white is made in two principal ways. The French process volatilizes the metal in a current of air and collects the oxide in closed chambers. The American process produces the oxide directly from the ore by burning finely granulated ore with powdered anthracite. The vaporized zinc combines with blasts of air forced through the furnace, and zinc oxide results. The ore used in this process is franklinite and is found in New Jersey. Titanium white is made largely from the ilmenite and rutile ores found in Florida beach sands.

Vehicles, Driers, and Thinners

A paint vehicle is an oil or mixture of oils. Those used are so-called *drying oils*, capable of hardening so

THE GEOGRAPHY OF PAINT AND VARNISH



The arrows show the regions of the world which in normal times send to the United States raw materials for making paints and varnishes. Some of the raw materials, like tung oil, soybean oil, and chemical pigments, are also produced at home, and many of the imported natural gums and resins are now being replaced by the synthetic resins developed in chemical laboratories.

that they bind the pigment particles together in a continuous film which clings firmly to the surface. The changes these oils undergo as they dry are caused by oxidation from exposure to the air, accompanied by an internal rearrangement of their chemical structure called *polymerization* (for an explanation of this term, see Plastics). These processes can be speeded up by the addition of special driers.

The oil may be mixed with a drier and heated before the pigment is added. This completes the early stages of the chemical change. The driers used in this way are usually oxides of manganese, lead, or cobalt, or manganese borate. Other driers may be added to the mixed paint just before it is applied. These include highly oxidized linseed oil and the kind of salts called metallic soaps, such as lead acetate, lead resinate, and manganese oleate. The so-called Japan driers contain, in addition to the metallic compounds, a resin such as shellac or rosin.

The most widely used paint vehicle is linseed oil. Raw linseed oil dries slowly and forms a tough elastic coat; boiled linseed oil dries more quickly but forms a hard brittle film. Mixtures of the two are often used, though the raw oil combined with a Japan drier is commonly recommended. Specially treated tung oil or soybean oil may be mixed with linseed oil (see Fats and Oils). A drying oil that has recently won favor as a paint vehicle is perilla oil, obtained from the small nutlike seeds of a plant (Perilla frutescens) of the mint

family native to China, Japan, and India. Another is oiticica oil, from the seed kernels of a large tree (*Licania rigida*) of northeastern Brazil.

To reduce the thickness of the paint so that it can be properly applied with a brush or by spraying, and to increase its penetrating properties so that it will imbed itself in the surface to which it is applied, a thinner is added. These thinners are volatile substances, which evaporate as the paint dries, leaving little if any permanent residue in the paint. The most commonly used thinner is turpentine. Besides its good solvent properties it acts as an oxygen carrier for the drying oils, and its rate of evaporation is suitable for good brushing and flowing qualities in the paint (see Turpentine). Other thinners are derived from petroleum (petroleum spirits) and from coal tar (solvent naphthas).

Calcimine and Other Water Paints

The simplest paints are water paints such as calcimine and casein paints. Calcimine usually means a water mixture in which animal glue or dextrine is used as the nonvolatile vehicle, and whiting as the principal pigment. It is an economical, quick-drying coating for interior walls and ceilings where little protection is needed. Rapidly rising in popularity are casein paints which contain casein as a binder, and a pigment such as lithopone or whiting, with water as the volatile solvent. These paints are popular because they are sold in paste form which have only to be mixed

with water to use. Little experience is required in applying them and they are inexpensive. They are used for interior work only because they do not withstand long exposure to moisture.

Varnishes and How They Are Made

A varnish is a kind of transparent paint in which a resin takes the place of the pigment. There are two principal types—spirit varnishes and oil varnishes. In a spirit varnish the resin is dissolved in a volatile solvent like alcohol or turpentine. Shellac is a varnish of this type. In drying, the solvent evaporates leaving nothing but a coat of resin. In an oil varnish, the resin is melted and then dissolved in one of the drying oils. The solution dries in the same way as paint, by the processes of oxidation and polymerization.

Originally all varnishes were made with natural resins. Chief of these are the copal resins, dammar resins, mastic, lac, and rosin. The copal resins include the fossil types, such as the Congo fossil, Zanzibar, Pontianak, and Kauri resins produced by trees long extinct. The dammar resins are obtained from living trees found chiefly in the East Indies. Mastic is the resin from a tree of the pistache genus, native to the shores of the Mediterranean. This resin must not be confused with the so-called mastic cement made of clay, litharge, and linseed oil. Lac, from which shellac is made, is produced by an insect, and rosin is the residue left after turpentine is distilled. (See also Gums and Resins.)

Today these natural resins are gradually being replaced by artificial or synthetic resins, chiefly those called *ester gums*. One of these is glyceryl rosinate, produced by the condensation of glycerin and rosin. A great many of the synthetic resins employed in the manufacture of modern plastics are also used for varnishes (see Plastics).

Variations in heat treatment or in some minor ingredient may greatly alter the characteristics of an oil varnish, and manufacturers are usually able to produce from the same basic formulas varnishes for a wide variety of purposes—waterproof and elastic spar varnishes, hard and quick-drying floor varnishes, and high-gloss varnishes for furniture and pianos. The driers and thinners used with varnishes are in general the same as those used for paints.

Enamels, Lacquers, and Stains

The paints sold under the name of enamels are essentially crosses between oil paints and varnishes. The varnishes used in their manufacture are made as pale and transparent as possible and the desired body pigments and other colors are added. They are properly called paint enamels to distinguish them from the fused enamels or glazes that are baked on the surfaces of pottery, bath tubs, kitchen utensils, and many other objects (see Enameling).

Similar to paint enamels but even harder and more durable are the *oriental lacquers* so often seen on Japanese, Chinese, and East Indian furniture and bric-a-brac. These are made from "natural varnishes" derived from the sap of several species of trees. The

modern synthetic lacquers, on the other hand, are altogether different in composition. They are more nearly like shellac and other spirit varnishes (see Lacquer and Shellac).

The substances classified as stains are distinguished from paints by the fact that they do not produce a surface coating. They are in fact merely wood dyes which penetrate and color the fibers, leaving the grain and structure of the wood plainly visible. Depending upon the liquid in which the dyes are dissolved, stains are classified as spirit stains, oil stains, and water stains. Certain of the stains are designed to bring about chemical changes in the wood fiber to make it acidproof or heat-resistant. Stained surfaces are often made glossy and waterproof by coats of varnish or by rubbing in an oil or a wax.

Methods of Applying Paint

For a paint to adhere properly there must be no water, grease, or dirt on the surface to be painted; otherwise blistering may take place, which loosens the paint and lets it chip off. Knots in all resinous woods should be shellacked before painting. Paint should not be applied in weather much below 40° F. because it will not dry properly and will start sagging. If paint is made too thin or applied too abundantly, running or sagging also may occur.

When painting new surfaces a priming coat is first applied. This is usually a thin flat paint which has good adhesive properties and which provides a grainy surface for the subsequent coats to anchor to. A second coat or body coat and a third or finishing coat are then applied. In repainting, the priming coat is omitted.

Paints, varnishes, or lacquers may either be applied by brush or spray guns. The usual paint brush is made from coarse black Russian or Chinese boar bristles. For spraying, the paint must be made thinner and for good results a pressure of at least 40 pounds per square inch should be applied to the spray gun. Small objects are often coated by dipping them into vats of varnish or enamel.

Virtually all kinds of paint are sold ready-mixed and these prepared paints are the best for inexperienced persons to use; but most expert painters prefer to mix their own. The body pigments are sold in the form of a paste, ground in linsced oil. To this paste is added more linsced oil, either raw or boiled, a drier, and a thinner. Color pigment is then stirred into the paint until the desired hue is produced. Enough paint should be mixed in the first place to complete the job in hand, since it is often very difficult even for an experienced painter to prepare a second batch that exactly matches the color of the first.

Paint Removers

Paint may be removed by applying to the surface a solution of lye in water. This undermines the paint and loosens it so that it may be scrubbed off. The lye, however, roughens the structure of the wood. Less harsh removers consist of solutions of benzene, wood alcohol, and acetone. A remover of this type

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softens up the paint or varnish so that it may be scraped away.

Decalcomania or Transfer Methods

Much decorative painting that used to be done by hand is now imitated by the decalcomania process. The decoration, design, or lettering is printed on a paper coated with a film of gum. When the paper is moistened and inverted on wood, metal, glass, or porcelain, the film with its design comes off the paper and transfers itself to the new surface. The design itself is waterproof and when dry stays firmly and permanently in place.

The decalcomania or transfer process was developed in the 19th century as an amusing by-product of lithographic printing, and the transfers were sold chiefly to children in toy stores. But today it has developed into an important industrial technique. Common examples of its use are the license "stickers" applied to automobile windshields.

Paint and Conservation

The importance of paint in conservation, sanitation, and public morale has come to be widely recognized. The frequent "clean-up and paint-up" movements testify to the part it plays in civic planning. In many cities the walls of dark alleys and side streets are painted in bright colors to make the neighborhood more cheerful and reduce accidents and crime. Safety rules demand that stair wells and elevator shafts be painted white. The right choice of paint for factories. offices, and schoolrooms has a noticeable effect on the spirit as well as the eyesight of those who work there. It is not surprising that each year sees paint used in the United States in greater quantities and more intelligently. (See also Color.)

THE HOLY LAND of Christians, Jews, and Mohammedans

PALESTINE. It was a glorious event when on December 11, 1917, quietly and unostenta-tiously, without pomp or blare of trumpet, General Edmund Allenby, commander-in-chief of the Allied armies in the East, entered the city of Jerusalem and delivered Palestine from the tyr-

anny of the Turks. Under their oppressive rule the people had suffered for centuries, and the once fertile land had become barren and desolate. For ages the hearts of half the world had looked with devotion and longing toward this land of Canaan, which was the Promised Land of the Israelites and the birthplace of Christianity. By Jew, Christian, and Mohammedan alike it is revered as the Holy Land.

Small in Area but Great in Influence

No other country has so many shrines as Palestine, and few other lands have seen more stirring events. Yet Palestine is a tiny country, occupying only a small part of Syria, and little larger than the state of New Jersey.

As one stands on the top of Mount Ebal-which, with Mount Gerizim opposite, guards the ancient city of Shechem (now Nablus)—and lets one's eye sweep over the landscape, one can view almost the whole of Palestine. To the west you see the deep blue waters of the Mediterranean, bordered by gleaming sand hills; to the east the Jordan River and-far to the north, beyond the boundaries of ancient Israel—snow-crowned Mount Hermon; while to the south you look upon Jerusalem on its height, and beyond to the southernmost hills of Judea skirting the wilderness.

One can drive across the entire country in a few hours, or can go from north to south in a single day.

Extent.—North to south, 265 miles; east to west, from less than 10 to about 80 miles. Total area (not including Trans-Jordan), about 10,430 square miles; population, about 1,600,000 (950,000 Mohammedans; 550,000 Jews; 100,000 Christians).

Monammedans; 550,000 Jews; 100,000 Christians). Physical Features.—From the coastal plain along the Mediterranean the land rises toward the east, forming a rugged plateau intersected by deep valleys and broken mountain ranges, highest point, Jebel el Jermaq (3,934 feet) in Galilee. To the east the plateau drops steeply into the depression down which the Jordan River, rising on Mt. Hermon (9,400 feet), beyond the northern boundary, flows south through the Sea of Galilee to the Dead Sea (1,300 feet below sea level).

south through the Sea of Galilee to the Dead Sea (1,300 feet below sea level).

Products.—Oranges, grapes; olives and olive oil; wine; soap; nuts, wheat, barley, durra, sesame, tobacco, watermelons; sheep, goats, camels; hides and skins, wool; salt, cement.

Chief Cities.—Tel Aviv (160,000); Jerusalem (about 135,000), Haifa (110,000); Jaffa 70,000); Hebron, Nablus (Shechem), Gaza, (all about 20,000); Lydda, Ramle, Safad, Tiberias, Nazareth, Acre, Bethlehem, Jericho.

Leaving the Mediterranean port of Jaffa, the traveler passes through beautiful orange groves and then across the flat plains of Sharon. Here in ancient times dwelt the Philistines, from whom the country got the name "Palestine," or the land of the Philistines (see Philistines). In some.

of the fields Arab farmers may be seen plowing in the same primitive fashion as in Bible times; while farther along, on the hillsides, shepherds in long robes and turbans still watch their flocks as did the Israelites in ancient days. On many farms, however, we find American-made plows and tractors of the latest design driven by the enterprising Zionists, who are using modern methods in this ancient land.

Camels still plod along the roads that lead up to Jerusalem, but automobiles are common. Even the Holy City has changed, particularly in the modern suburbs around it, though the ancient sacred places are still the chief attraction to tourists (see Jerusalem).

From Jerusalem to Jericho and the Jordan

From Jerusalem a winding and precipitous road leads down to Jericho, which occupies an oasis in the wilderness, nearly a quarter of a mile below the level of the sea. The first place to fall before the Israelites when they entered the Promised Land, it was already a city noted for its wealth and luxury. The Romans rebuilt it and made it so splendid that Antony chose it as a gift to present to Cleopatra. Then again it fell into ruin. A small modern settlement marks the site of this famous "City of Palms."

A few miles farther and we are at the banks of the river Jordan, which we find thronged with Christian pilgrims who have come to bathe in the muddy turbulent waters of this historic stream. Each sect

ON THE BANKS OF THE SACRED RIVER JORDAN



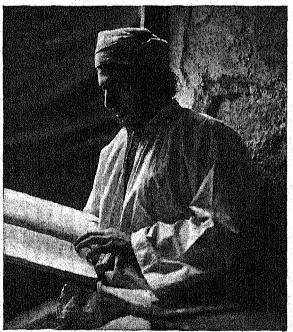
This is the stream in which Christ was baptized by John the Baptist. Today guides conduct travelers through this region. The river is so quiet because of its nearness to the Dead Sea, whose salty waters back into it. The climate and the vegetation along the lower Jordan are much like those of Florida.

has a different bathing place, which each claims to be the exact spot where Jesus was baptized by John the Baptist. Tarfatrees, willows, and tall poplars, luxuriant thickets of myrtle, oleander, and other shrubs, clothe the banks here; but as we follow the swift stream southward to the Dead Sea the vegetation takes on a sickly look.

Occupying the lowest part of that great chasm through which the Jordan flows, the Dead Sea is almost 1,300 feet below the surface of the Mediterranean. Its water is five times as salty as that of the ocean. If we try to swim in it we cannot possibly sink, but bob up and down like a cork. This extreme saltiness is due largely to the rapid evaporation caused by the

intense heat. Each of the many streams that flow into it brings a small amount of salt, which remains, while the water passes off as vapor. The Dead Sea deserves its name, for it contains only the lowest kinds of animal life, and fish put into its brilliantly blue and clear waters soon die.

A SAMARITAN READING THE LAW



Only a few families remain in Palestine today to represent the ancient Samaritan people. They recognize only the Pentateuch (the first five books of the Bible) as sacred and claim that the orthodox Jews have departed from the pure Mosaic teachings.

Yet this abode of desolation has become a valuable source of revenue, for it contains large amounts of potash, bromine, and other salts, which can be extracted by evaporation. The river Jordan is also being made to serve an economic purpose, for it has been harnessed to supply several cities with electric light and power.

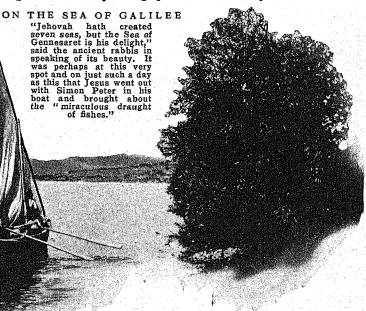
Climbing back over the barren hills of Judea, we reach Bethlehem, where Jesus was born (see Bethlehem). A few miles farther south, in the ancient city of Hebron, is the cave where Abraham. Isaac, and Jacob are supposed to lie buried. About this place has been built a Moslem mosque, for the Mohammedans regard great patriarchs with reverence equal to that of the Jew or Christian.

Passing to the north we cross Samaria and reach the fertile, well-watered, and pleasant land of Galilee. Here, nestling among the hills, we find the town of Nazareth, where Jesus spent his boyhood. Not far away, to the east and north are the calm blue waters of the Sea of Galilee (Lake of Gennesaret or Tiber's...s). On these shores Jesus often walked, and here he met the fishermen who became his apostles. Now the region is quieter than it was in his day. Only a few scattered boats are seen on the waters, which were once covered with sails. With the exception of Tiberias, which has been rebuilt, the ring of cities

whose stately buildings were reflected in its waters have fallen, leaving only heaps of ruins. But the lake has not lost its serene beauty. Its waters drain southward through the Jordan into the Dead Sea.

Ascending one of the hills of

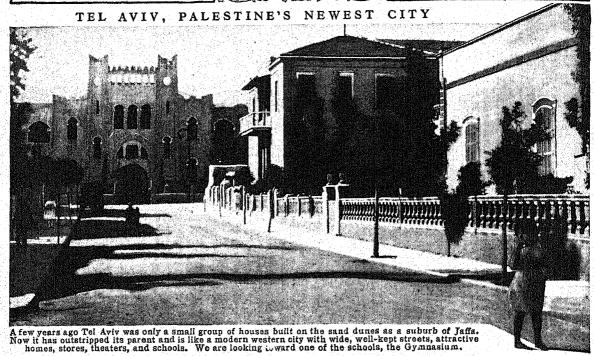
Ascending one of the hills of Galilee and looking eastward, we see across the Jordan the heights In material things Palestine is not a rich country. Its natural resources are few. It has few minerals—no coal, no iron, no copper, no silver. The ancient Israelites, coming to it from the wilderness, called it "a land flowing with milk and honey"; but it was only through patient toil that they won an abundance



of Gilead with their forests of oak and terebinth or Chian turpentine trees. To the south is the famous Plain of Esdraelon, the vast arena in which so many battles have taken place. Armies from the great empires of the Nile and of the Euphrates, from the north and the south, from the east and the west, have here met in deadly conflict. In the early days of Israel's history Barak and Gideon won here their splendid victories; and here Saul met defeat against the Philistines and Josiah against the Egyptians. Here the valiant Maccabees won freedom for the Jewish people; and in the Middle Ages many a Crusader died in the Plain of Esdraelon fighting for the cross. Napoleon's advance from Egypt was here checked by the Turks and British. In the World War of 1914-18 the Allies won Palestine from the Turks in this field; and it is supposed to be the Plain of Armageddon to which the Book of Revelations refers as the place where "the kings of the earth and of the whole world" are to gather for "the battle of the great Day of God Almighty," the Day of Judgment. Today, however, the Plain of Esdraelon is a scene of peace and beauty, the home of prosperous Zionist agricultural colonies. This naturally fertile region, which through generations of neglect had become a land of pestilential swamps and barren wastes known as "the Valley of Death," has been reclaimed through the labor and sacrifice of Jewish pioneers, and is an important grain-growing region. for their needs, and it is not surprising that after so many centuries of neglect much of the country should have become a waste. Even in Palestine's palmiest days water was so scanty as to be considered extremely precious. All through the Bible we find praise of water-of brooks and springs and wells. Though there is considerable rainfall in Palestine, it is not evenly distributed throughout the year. Practically all of it falls during the winter months, beginning in October or November with the "early," or "former rain," and ending with the heavy showers of March and April, called in the Bible the "latter rain." Much of the rain, too, percolates through the limestone rock and is thus wasted. The great forests, which in ancient times helped to conserve the moisture, had almost disappeared, but large areas are now being reforested. Already millions of trees have been planted. Irrigation projects have been developed and have reclaimed much of the land that was wilderness.

Remarkable improvements have been made in transportation. During the first World War the British built a double-track railroad from Port Said to Haifa, which has superseded Jaffa as the chief seaport of Palestine. This connects with the Turkish line to Constantinople, so that it is possible to go by rail from Cairo to Constantinople. Other railroads and excellent motor roads link all the chief towns.

In the settlement that followed the World War, Palestine was taken from the Turkish Empire and all



west of the river Jordan was put under British rule by mandate of the League of Nations. Already the government had in the famous Balfour declaration of November 1917 pledged its aid toward the realization of the Zionists' dream of "establishing in Palestine a national home for the Jewish people."

Much has been done toward the realization of this dream. Not only has agriculture been developed, but a number of industries, of which there were practically none before the war, have been established. A striking instance of the progress due to Zionist activity is seen in the Jewish city of Tel Aviv. Established in 1909 as a suburb of Jaffa and built on what was only a waste of sand dunes, it has grown into a city of about 160,000, so modern and progressive that it has been said, "Jaffa is to Tel Aviv what the camel is to the motor car." Sanitary conditions have been

improved throughout Palestine and modern methods have been successfully used in combating disease. Hand in hand with the economic development has gone a revival of learning. A center of Jewish culture and research has been established in the Hebrew University at Jerusalem. Here, as in the other Jewish schools, the Hebrew language is the medium of instruction.

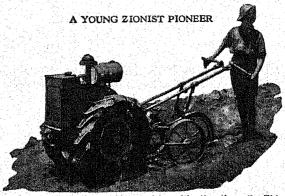
But many grave problems remain. The sandy barrens are hard to cultivate, and the task is doubly hard because most Jews have long been unaccustomed to farming. Moreover, the colonists are largely dependent on one crop, citrus fruits, which forms fourfifths of the exports.

But the greatest difficulty is the enmity of the native Arabs. These Mohammedans, heirs of an old civilization hostile to change, resent the settling of another race and religion in the land they have occupied so long. Despite the flood of Jewish immigrants, the Arabs have kept a two-thirds majority in the population, swarming in from near-by regions to share Palestine's new prosperity.

Rising nationalist feeling resulted in destructive anti-Jewish riots, accompanied by violent deeds and bloodshed. A serious outbreak occurred in 1929 over Jewish rights at the Wailing Wall (see Jerusalem).

Time and again England intervened with troops and bombing planes. Continued violence led England in 1939 to abrogate the Balfour declaration and to propose that Palestine should become an independent state in ten years, with a perpetual one-third Jewish minority. (See also Arabia and the Arabs; Jews; Syria.)

Trans-Jordan. Ancient Palestine included land to the east of the Jordan as well as to the west. The country to the east, known



Boys, and girls too, are taking part in cultivating the soil. This student at one of the agricultural colleges is learning to use modern machinery in this ancient land. American tractors and agricultural machinery are widely used.

THE ROAD INTO THE LAND OF CANAAN



An Arab herdsman is watching his sheep in the region where Abraham, Isaac, and Jacob drove their flocks. Strange—isn't it?—that this ancient land should have been inherited by the sons of Ishmael the Wanderer, the one whom Abraham drove forth into the desert, while the sons of Isaac are scattered the world over! But wanderers these modern Ishmaelites remain. That's the herdsman's tent down there in the valley, and tomorrow perhaps he and his flock will be far away.

as Trans-Jordan or Kerak, is controlled by Great Britain as a separate territory under the Palestine mandate. The mountainous regions of Gilead, Moab, and Edom, just east of the Jordan, are the most fertile parts of the country, producing grapes, wheat, and other crops. Beyond this the land is largely desert. The population is about 260,000, of whom 220,000 are Arab Moslems, 30,000 Arab Christians, and the remainder chiefly Circassians. The capital is Amman, which in Greco-Roman times was known as Philadelphia and was an important center of culture.

PALM. The silhouette of the palm tree, with its tall slender unbranching trunk surmounted by its wonderful crown of enormous leaves, is a sight which one could never forget or fail to recognize at first glance. The trunk mounts straight into the air, often for a hundred feet or more, suddenly bursting at the top into a rosette of leaves radiating from it like the outspread fingers of the hand. It is this resemblance that gives the palm its name, from the Latin word palma, meaning "palm of the hand."

In addition to these tall stately ornamental varieties, which include those with which we are most familiar—such as the coconut, the date, and the royal palm—there are other species which have quite different habits. Some of them, like the familiar potted palms in our houses, are mere shrubs. The dwarf palmettoes have buried stems and form low scrubby growths covering the ground like weeds, making, with their large prickly leaves, a well-nigh impenetrable thicket. Others, such as the rattar palms, have long slender ropelike stems which climb like vines and often are several hundred feet long.

Of these beautiful trees, more than 1,200 species have been described. They are found mostly in the Pacific islands, in Asia and America, and a few in Africa. Though they reach their greatest development in the rainy tropics, some species, such as the date palm (which is believed to be the palm of the

Bible), grow in very arid regions, and others extend well into the temperate zone. Over 60 species of hardy palms are grown in California, where one of the most striking trees is the California fan palm. South Carolina is nicknamed the "Palmetto State" from the palmetto (Sabal palmetto), a small fan palm, which abounds in the lowlands and on the islands along the coast.

Palm leaves are of two main types: fan-shaped (palmate), as in the common fan palm and palmetto; and feather-shaped (pinnate), as in the date and the coconut. In some species the leaves are 30 to 45 feet long and 4 to 8 feet wide. The flowers are small and usually white, greenish, or yellow in color; they are borne in large clusters in the crown of leaves. The fruit in some species is no larger than a pea, while in others, as the double or sea coconut, it is sometimes larger than a man's head.

Next to the cereals and other members of the grass family, the palms are the most useful of all plants. Their fruits, stems, and leaves are used in a great number of manufactured products, besides furnishing food, shelter, and clothing for the natives of the regions in which they abound (see Coconut Palm; Date Palm; also pictures on the next two pages).

Among important palm products may be mentioned palm-oil, derived from the fruits of the oil-palm (Elacis quineensis) and other species, used for food, in soap-making, and as a lubricant; palm-wine, from the sap of several species; sago, from the pith of the sago palm (Metroxylon) and other varieties; rattan, the thin flexible stems of various species of Calamus; vegetable ivory, the nuts of the tagua or ivory palm (Phytelephas macrocarpa), from which buttons and many other small articles are manufactured. Many valuable fibers used in making brushes, hats, and baskets are derived from palms. Some of the commonest kinds are raffia, piassava, kitool, African fiber, palmetto, and coir or coconut fiber. Palms are the largest of all the Monocotyledons and belong to the family of Palmaceae.

USEFUL PALMS FROM MANY LANDS 1

i. A native of Ceylon scaling the long, slender, leaning trunk of a Coconut Palm. This palm thrives on tropical coasts and islands throughout the world. 2. One of the many Fan Palms from which fans and roof thatching are made. 3. An Arab gathering a meal of dates from a Date Palm in Algeria. 4. Looking down into the heart of a young Sago Palm. The pith of these palms is made into the sago of commerce. 5. Those ropelike stems are Rattan Palms on the island of Java. They run over other trees or along the ground and may grow several hundred feet long. Strips from the stems are woven into ropes, mats, and furniture.

SOME AMERICAN PALMS AND PALM-LIKE TREES



6. A group of Cabbage Palms in Florida. These belong to the species called Roystonea oleracea, not to be confused with the cabbage palmettos. 7. An avenue of Royal Palms. This palm (Roystonea regia) is a relative of the cabbage palm. 8. These Washington Palms are natives of the southwestern United States. 9. The so-called "Traveler's Palm" or "Traveler's Tree" is not a true palm, but is a relative of the banana from which thirsty wayfarers can get refreshment by tapping the supply of water stored in its base.

One species is found in South America, another in Madagascar.

PALMYRA (păl-mī'ra), Syria. From the beautiful "city of palms," Queen Zenobia more than 16 centuries ago ruled over a kingdom extending from Palestine to the Euphrates. Today magnificent ruins rise from the desert in mute and lonely testimony to the glory of the past. The traveler may reach them in a few hours by

automobile from Damascus, about 170 miles to the southwest. Palmyra was once a capital of rare splendor. It can never have been more than a square mile in area, but the whole of that space made beautiful. was Through the center for nearly a mile extended a great quadruple colonnade of rosy-white limestone, 750 columns in all, each of them 55 feet high, and terminating in a triumphal arch. Beyond this, upon a terrace, stood the Temple of the Sun, its court surrounded by pillars intricately carved.

The wealth which made this beauty possible began to pour into Palmyra before the Christian era, when the oasis in which the city stood became a trade post on the camel route by which the silks,

perfumes, and jewels of the East were brought to the Mediterranean world. Heavy toll was taken from the caravans in return for protection from the desert tribes, and duties were levied on all imports and exports. The city's most splendid period extended from 130 to 270 A.D., when political importance was added to wealth by Rome's recognition of Palmyra as a valuable buffer state against the rising empire of New Persia. Zenobia's husband Odenathus was made viceroy of the East, in return for military operations against Persia. His glory was shortlived, for he was assassinated in 267, in the zenith of his success.

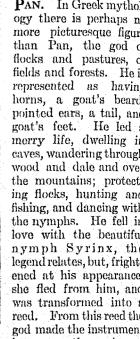
After her husband's death, Zenobia sought independent empire for her son, but the story of her splendid defiance of Rome-which you may read in Chaucer's 'Monk's Tale'-had a tragic ending. Her armies could not match strength with the vigorous soldier-emperor Aurelian, whose desert march to Palmyra was an achievement worthy even of a Roman, and in 274 the queen in golden chains graced his imperial triumph. The city was destroyed and thereafter the caravans took other routes.

From the hills that fringe the westward approach. the traveler today sees the main caravan road lined

with colonnades and the pedestals that once held the statues of famous Palmyrenes. He sees the remains of the great Temple of the Sun, built in the time of Augustus Caesar, a theater, an aqueduct, the senate house, beautiful villas, and tower tombs as high as eight stories. Palmyra is the Tadmor of the Bible

> (II Chron. viii, 4), which is said to have been built by Solomon.

> PAN. In Greek mythology there is perhaps no more picturesque figure than Pan, the god of flocks and pastures, of fields and forests. He is represented as having horns, a goat's beard, pointed ears, a tail, and goat's feet. He led a merry life, dwelling in caves, wandering through wood and dale and over the mountains; protecting flocks, hunting and fishing, and dancing with the nymphs. He fell in love with the beautiful nymph Syrinx, the legend relates, but, frightened at his appearance, she fled from him, and was transformed into a reed. From this reed the god made the instrument known as the syrinx or Pan's pipes.



The mischievous Pan took delight in coming upon travelers unexpectedly and exciting the sudden fear which has come to be called "panic." He is often represented as accompanied by roguish, goatlike beings much like himself, called satyrs. These were the fauns of Roman mythology, the companions of Faunus, who occupied a position similar to that of Pan. The worship of Pan was introduced into Athens from Arcadia about the time of the Persian Wars, because of his supposed aid to the Athenians in the battle of Marathon.

In later times Pan came to be regarded as the god of universal nature, through confusion of his name with another Greek word meaning "all," and finally came to stand for all the Greek gods, and for paganism itself. So a legend arose that when Christ was born, a mighty voice proclaimed through the isles of Greece, "The great Pan is dead!" Thus was heralded the end of the power of the old divinities and the beginning of the new faith.

Pan, dancing and playing his pipes, is a familiar figure in painting and sculpture. One of these, the Satyr or Faun attributed to Praxiteles, inspired Hawthorne's novel 'The Marble Faun'.



This great temple shows clearly the Greek influence which overspread ancient Syria. The temple before it fell into ruins, consisted of 390 columns in double or triple rows, and covered a terrace 750 feet square. It was surrounded by a wall 50 feet high.

The REPUBLIC at the Crossroads of the NEW WORLD

Panama (păn-à-mā'), Republic of. For more than four centuries the isthmus which is now the Republic of Panama has been the crossroads of the New World. Upon the narrow stretch of jungle which here separates the Atlantic from the Pacific and North from South America has rested the fate of fortunes and empires

in the Western Hemisphere.

When Spain ruled the Americas, a mere rock-paved trail linked the oceans, but over it passed the fabulous wealth in gold and silver won by the Spanish conquerors. Gold was again the motive when centuries later the isthmus was spanned by a railway to transport prospectors to California. Not gold or silver but trade wrote the final chapter in this story—the construction by the United States government of a canal cutting apart the continents and uniting the oceans (see Panama Canal).

A Long, Narrow Country

Panama's stirring past is thus the natural outcome of its commanding location. In size, this little Central American republic, with an area of 32,-380 square miles, is not as large as Maine. It stretches like a caterpillar from Costa Rica to Colombia—its greatest length 480 miles, its width ranging from 31 to 100 miles.

Its northern shores are washed by the Caribbean Sea and its southern by the Pacific. Off the long curving coast line, 1,244 miles in length, are many scattered islands, chiefly the Pearl Islands in the Pacific, and in the Caribbean, the San Blas group (known officially as the Archipiélago de las Mulatas). The country is cut in two by the Canal Zone, a strip of land five miles wide on each side of the Panama Canal, over which the United States exercises jurisdiction.

Low forest-covered mountains enclose broad valleys and plains in most of the country, though some peaks at the Costa Rican border are more than 11,000 feet high. There are no natural lakes, but many small rivers and streams. The climate is hot and wet. Except at the higher altitudes, there is little variation from the average annual temperature of 80° F. The rainy season is from April to January, with the heaviest downpour along the Caribbean coast, where the rainfall averages 140 inches a year.

The combination of heat, rain, and naturally rich soil has produced thick jungles in the lowlands. Despite their riotous beauty and immense fertility, these

jungles were a deadly menace to life until the United States introduced sanitary measures which almost wiped out tropical diseases.

Products and Trade

More than half the republic is uninhabited and almost an unexplored wilderness, and of the rest only a

small part is under cultivation.

Bananas grown on great plantations along the coasts are the major crop and the chief export. Coconuts, cacao, coffee, sugar cane, and tobacco are also leading agricultural products. Excellent pasture lands support an extensive live-stock industry. The forests yield an abundance of cabinet, dye, and building woods, as well as increasing amounts of rubber.

Gold was mined before the Spanish conquest, and it still is; other mineral deposits, such as manganese, silver, aluminum, and copper, have been little exploited. Magnificent parts have been obtained for

Gold was mined before the Spanish conquest, and it still is; other mineral deposits, such as manganese, silver, aluminum, and copper, have been little exploited. Magnificent pearls have been obtained for centuries from the Pearl Islands. Coral, sponges, mother-of-pearl, and tortoise shell are other treasures garnered from the sea. Manufacturing is limited largely to sugar refining. Transportation also is little developed.

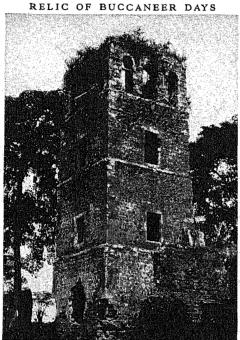
Trade with the United States usually accounts for more than

usually accounts for more than half of Panama's imports and more than three-fourths of its exports by value. An odd source of revenue is the large number of foreign-owned merchant vessels which fly the flag of Panama in order to benefit from the country's low registration fees. At the outbreak of the European war in 1939, many merchant ships of the United States were registered in Panama to escape American neutrality laws prohibiting them from entering the ports of belligerent nations.

Panama City and Other Towns

On the Pacific, inside the Canal Zone, is Panama City, the nation's capital and largest city. Founded in 1519, it is the oldest settlement on the American mainland. For centuries it was the clearinghouse and stronghold of Spain's empire in the New World. Today, through its port of Balboa, it is one of the world's greatest shipping centers. Though the churches and other old buildings preserve the ancient charm, the city is modern, with many fine promenades and government buildings.

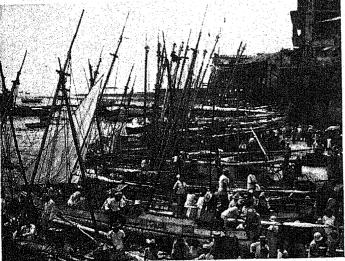
Colon, the second largest city and port, is also within the Canal Zone. In both cities, though they



This tower was almost all that remained of Panama City after it was looted and burned by Sir Henry Morgan, the English pirate, in 1671. Two years later the town was rebuilt five miles west of the old site, which is now only a tourist attraction.

are under the jurisdiction of the republic, sanitation is controlled by the United States, which has made them among the most healthful in the tropics. Colon was founded in 1850 by Americans who chose this site

MARKETING PANAMA'S CHIEF CROP



At this busy market in Panama City, natives are unloading bananas, grown on the plantations along the coast and transported by these little fishing sloops to the city. In an average year, nearly 6,000,000 bunches of bananas are exported, mostly to the United States.

as the Atlantic terminus of a railway they were building to Panama City. Porto Bello, now virtually uninhabited, was the scene of wild adventures in the days when, linked to the Pacific by the "gold road," it was the Atlantic port for shipment of Spanish plunder.

The People and Their Culture

Of the population of about 535,000, the whites and the Negroes each make up about 15 per cent, and the Indians less than 10 per cent. The mestizos, of mixed white, Indian, and Negro blood, constitute more than half of the people. Efforts to settle Europeans on the land have met with little success, chiefly because of the tropical climate. In Panama, unlike many other Latin American countries, foreign control of resources is not great. The whites live on the big plantations and in the towns, and the land is worked in rather primitive fashion by native labor.

The language is Spanish, but English is spoken by many businessmen. Catholicism is the religion of the majority of the people. Education is compulsory up to the age of 15 years, but about half of the people still cannot read or write. There is a National University

in Panama City.

Its History—a Saga of Transportation

In 1502 Columbus, on his fourth voyage to the New World, explored the Caribbean coast of Panama in search of a water route to the Orient. In 1513 Balboa, also in the service of Spain, hacked a path through the isthmus jungles to discover the Pacific. Three years later Pedro Arias de Avila, governor of the colony, gave it the name Panama from an Indian phrase meaning "abundance of fish."

As the main highway of Spain's New World Empire, Panama played a dominant, stirring rôle in colonial history, First it was contained in the viceroyalty of Peru, then (1718) in the viceroyalty of New Granada, which included Colombia. When Colombia freed itself from Spain, Panama in 1821

became part of the newly created republic. Despite a vigorous movement for independence, Panama remained under the rule of Colombia until 1903.

That year, on November 3, the people of Panama declared their independence. Their revolt followed Colombia's refusal to permit the United States to take over from a French company the building of a canal across the isthmus. President Theodore Roosevelt quickly recognized the new republic, and on November 18 the two countries concluded a treaty authorizing the transfer of the French rights and leasing to the United States the Canal Zone. Panama received the \$10,000,000 which Colombia had considered insufficient, as well as an annual rental of \$250,000 (beginning in 1913). Colombia charged that President Roosevelt had violated neutrality in fostering Panama's revolution. It requested, and later received, an indemnity from the United States. (Sec Colombia.)

Under the treaty of 1903, the United States guaranteed Panama's independence. At Panama's behest, this pledge was eliminated in a supplementary treaty concluded between the two nations in 1939. Nevertheless, the United States was granted the right to take whatever steps were necessary to defend the Panama Canal if it should be threatened. Under this treaty the United States, with Panama's per-

mission, established air bases at points outside the Canal Zone and built a military road from ocean to ocean.

During the second World War intense Axis propaganda failed to sway the strategically important nation. In December 1941 it joined the United States within a week in declaring war on the Axis. (See also Central America; Latin America.)

STREET IN THE OLD FRENCH QUARTER



The Old World atmosphere of Panama City is preserved in the architecture of buildings like these. From the trellised balconies, one might imagine this a town in Spain or France.

The PANAMA CANAL-from Tragedy to TRIUMPH



Where this ship is floating there once stood a high connecting ridge—part of the great Continental Divide of the Americas. Now the Panama Canal passes through it. The cleft shown here is called the Gaillard Cut. In the distance is a dredge clearing the channel of the silt that washes down from the steep sides. What this spot looked like while the engineers were at work and before the water was let in, is shown by the photograph on the next page, made from almost exactly the same angle.

Panama canal. steaming strip of rugged jungle where the Isthmus of Panama narrows to 30 miles has been for centuries a focal point of world transportation. In ancient geologic times there was a natural channel across here, but the land rose and blocked it. Early Spanish explorers searched the coast eagerly for a strait through which they could sail from the Atlantic to the Pacific. They wanted to go on to the mar-

kets of the East Indies, without the long, tedious voyage around the tip of South America.

Finding no waterway, the Spaniards soon made the isthmus a land link in their transport of treasure from Peru and other colonies on the west coast of South America. Sailing vessels brought gold and silver to Panama City on the Pacific side. Mule trains carried it over a narrow cobbled trail to Porto Bello or Nombre de Dios on the Caribbean, where galleons

Chief Facts About the Canal

Work begun by the Americans, May 4, 1904; canal opened, Aug. 15, 1914. Total length of canal, 50.7 miles; bottom width of channel,

300 to 1,000 feet. Number of locks, 12; length of each, 1,000 feet; width, 110

feet.
Height of Miraflores Lake, 54% feet above sea level; of Gatun Lake, 85 feet above sea level.
Amount of earth and rock excavated before opening of the canal, 239,000,000 cubic yards. Total cost of the canal, including payments to Panama, the French Company, and for sanitation, \$375,000,000.
Time needed for vessel to pass through canal, 6 to 8 hours. Distances saved: New York to San Francisco, 7,878 miles; New York to Yokohama, 3,768 miles; New Orleans to San Francisco, 8,868 miles; Liverpool to San Francisco, 5,666 miles.

San Francisco, 8,000 mines, Everyou to San Francisco, 5,666 miles.

Government of Canal Zone: by a governor appointed by the President of the United States, assisted by the heads of the various departments, such as those of operation and maintenance, supply, accounting, and health.

waited to freight it across the Atlantic to Spain. This route was faster and safer than the voyage around the Horn. Its rich traffic made Panama a frequent prev of looting pirates. But the dream of a waterway between the oceans persisted.

Flourishing world trade in the 19th century intensified the demand for a quicker, shorter route between East and West. When gold was discovered in California in 1849, there was no trans-

continental railroad in the United States. Thousands of people from the eastern states went by ship to Panama, walked across the isthmus, and then embarked again for the gold fields. By 1855 an Americanbuilt railroad between Colon and Panama City had been completed, on which travelers willingly paid 50 cents a mile. Still the dream persisted of a canal through which the ships themselves could cross from ocean to ocean.

CARVING THROUGH THE MOUNTAIN AT GAILLARD CUT



Slicing through the Continental Divide at this point proved one of the hardest jobs in building the canal. Again and again great earth slides undid the work of months, burying railroad lines and steam shovels. First called the Culebra Cut, it was renamed by President Wilson in 1914 in honor of Lieut. Col. David Gaillard, the engineer who had charge of the excavation.

An obstacle to canal construction greater even than the rocky ridges of the isthmus was the deadly threat of disease. Malaria, yellow fever, and bubonic plague scourged the entire region. Europeans and Americans were particularly susceptible. When the railroad was being built, tropical diseases are said to have killed more than 800 of the workmen.

French Project Ends in Failure

The first to attempt the stupendous task was a French company under Ferdinand de Lesseps, who had completed the Suez Canal in 1869 (see Suez Canal). With a concession from the Republic of Colombia, of which the isthmus was then a part, De Lesseps spent two years in surveys. Actual digging began in 1882. By 1889, the project had failed and the company was bankrupt. Disease had thwarted the best efforts of the builders—disease coupled with the mismanagement and dishonesty of the promoters who worked behind De Lesseps' back. A number of French public men were ruined by the scandals of the "Panama Affair."

During the seven-year construction period 22,000 men died of disease, although the total of those employed at any one time did not average more than 10,000. Yellow fever alone killed 2,000 of the white men who tried to fill the 1,600 jobs open to them. No man was surprised if the friend he had seen in the morning was lying in his grave at night. Medical men

at that time did not know the causes of malaria and yellow fever or that the diseases were carried from patient to patient by the bite of certain mosquitoes. The story goes that the French physicians would stand the legs of the hospital beds in bowls of water to keep out crawling bugs, thus furnishing a breeding place for the deadly mosquitoes right in the sickrooms. Outdoors, every swamp, stream, or pool in this hot, rainy region spawned new swarms.

The United States Undertakes a Gigantic Task

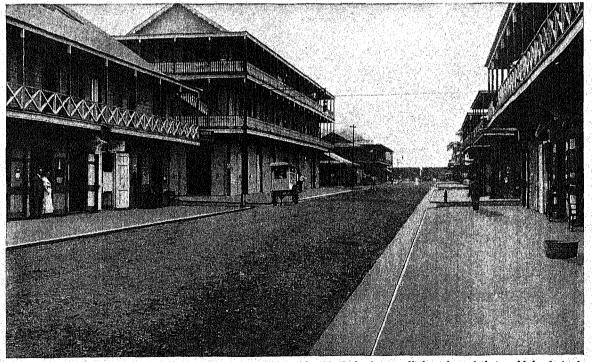
Meantime the interest of the United States government in the canal project had quickened. The senate had ratified the Clayton-Bulwer Treaty with Great Britain in 1850 providing for the neutrality of such a canal whenever it was built. Surveys had been made of various routes, and opinion was divided between Panama and the longer route by way of Lake Nicaragua. The Spanish-American War had focused attention on the need for a faster way to move warships between the Atlantic and the Pacific.

The withdrawal of the French company directed attention anew to the Panama route, and in 1903 the United States bought out the French rights, including the Panama Railroad, for \$40,000,000. An additional payment of \$10,000,000 was made to the newly formed Republic of Panama, which now occupied the canal area (see Panama, Republic of). In return, the United States was granted all rights to the "Canal Zone"—a

CLEANING UP THE CITY OF COLON



One of the first tasks of the American engineers was to clean up the towns. These two photographs show the same section of Tenth Street, Colon, before and after paving. Paving the streets not only made traffic easy, but it gave the city a new appearance and made the residents eager to keep clean.



Gorgas, the American army doctor, commanded the fight for health. He drained every ditch and pond that could be drained, and over those that could not be drained he spread a film of oil which killed the mosquito larvae. He destroyed all vermin, burned all rubbish, screened windows, doors, and porches; provided sewage disposal and a pure water supply. From one of the most unhealthful spots in the world, the Canal Zone became one of the most healthful. The death rate for employees during the ten years of construction work was only 1.7 per cent. Continued sanitary activities since the opening of the canal had dropped the death rate to 0.6 per cent by 1937. This remarkable achievement in Panama set an example that has led to better health in other tropical regions.



strip ten miles wide extending from ocean to ocean. Under the treaty with Panama, the United States was to pay a rental for this zone of \$250,000 a year. (In 1939, after the devaluation of the dollar, the rental was fixed at 430,000 Panamanian balboas.)

To two United States Army colonels goes credit for achieving success where the French had failed. Colonel George Washington Goethals, as engineer in chief after 1907, directed construction. Colonel William Crawford Gorgas of the Medical Corps, as chief sanitary officer, led the battle against disease. Later, both became major generals (see Goethals; Gorgas).

The United States took possession of the canal property on May 4, 1904, and the first two and one-half years were given over to the careful preparation that brought health, efficiency, and speed when actual construction started.

Gorgas Conquers the Mosquito

Since the days of the French adventure, two medical discoveries had been made that prepared the way for the achievement of Colonel Gorgas. In 1898 Dr. Ronald Ross, an English army surgeon, had discovered that malaria is conveyed by the bite of the Anopheles mosquito. In 1901 Dr. Walter Reed, a surgeon in the United States Army, and his associates had proved that yellow fever is passed from man to man by the Aëdes mosquito (see Mosquito). Gorgas himself, while serving as chief sanitary officer in Havana, Cuba, had directed the development of practical methods of sanitation based on these discoveries. With this invaluable knowledge and experience as guides, he set to work to make the Canal Zone a safe place for men to work—a safe place for them to live and rear their families.

He drained every lake, swamp, pond, and ditch that could be drained. Over those that could not be drained, he spread a film of oil to destroy mosquito eggs and larvae. He cut grass jungles to the ground, destroyed vermin, and burned rubbish. He raised all buildings above the ground, and screened windows, doors, and porches with fine wire screens, and ordered householders to cover all vessels that held water. He screened every train, and on every train he put a hospital car. He built hospitals for isolation and treatment. Cities were given sewers and pure water.

Ships coming from disease-ridden areas were placed under strict quarantine. To guard against bubonic plague, rats and fleas were killed and houses made rat-proof.

Gorgas began his work in May 1904. In May 1906 the last case of yellow fever occurred in Panama. The conquest of malaria was slower, but the number of cases dropped year by year. By 1914, when the canal was opened, only 82 out of each 1,000 employees went to the hospital with malaria. During that year only seven employees died of the disease. With an average of 39,000 employees during the ten years, the deaths from all causes averaged only 663 each year. This death rate of 17 per thousand was lower than that of many American cities of that period.

Here was one of the most impressive victories ever won by science against disease, and the cost of all the sanitary measures involved amounted to about one cent a day for each inhabitant.

Recruiting Labor, Assembling Machines

Preparations for construction were carried on under the supervision of the Isthmian Canal Commission appointed by President Theodore Roosevelt, with John F. Stevens as chief engineer. To recruit the large working force required, the commission set up agencies in the United States, Europe, and the West Indies. Meanwhile, buildings were started and equinment assembled to house, feed, and safeguard the men Unskilled or semi-skilled workers were recruited. paid in silver coin, while the skilled craftsmen and those occupying executive, professional, and higher clerical positions were paid in gold. This classification of workers into "silver" and "gold" employees has persisted since the canal has been in operation, though all are now paid in paper money.

The construction equipment that had to be assembled included mammoth steam shovels, locomotives, track-shifters, pile drivers, dredges, steamboats, and tugs. The railway had to be reorganized. A civil government for the Canal Zone had to be established, with courts, police force, fire companies, customs and

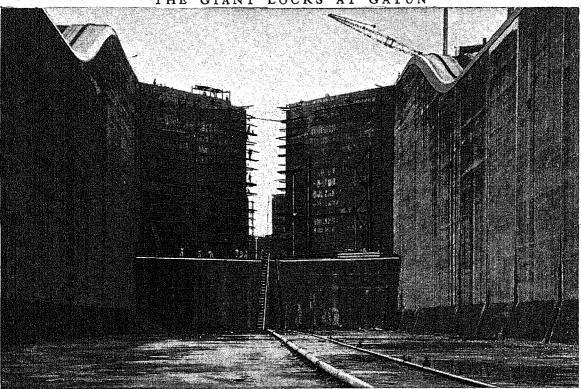
revenue service, and a postal system.

Goethals Directs the Battle of the Builders

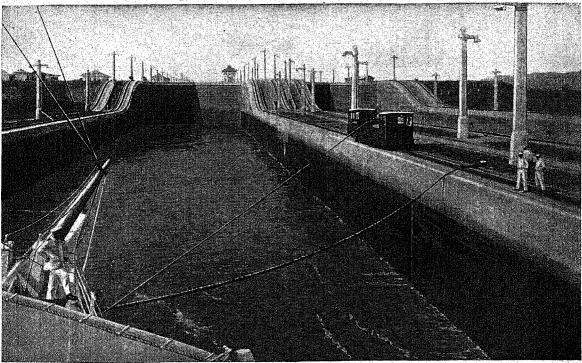
In 1907 Stevens resigned, and President Roosevelt appointed Colonel Goethals chief engineer and chairman of the Canal Commission. He had complete control of construction. From then on the work was to be done by the government under army supervision, instead of by private contractors as previously planned.

For the next seven years an observer in the Canal Zone could have seen such a sight as the world perhans had never witnessed since the building of the Pyramids or the Great Wall of China. The tropical sun beat down upon a 40-mile long panorama of industry. Swarming in the mighty cuts were legions of sweating laborers, white and black, some in shirt sleeves, some almost naked. Some toiled with pick, shovel, and crowbar; others with drill and dynamite in the stone cuts. Series of cableways and a network of railway tracks ran everywhere. Mighty derricks and cranes swung huge buckets of concrete through the air and lowered them into the forms to build locks and embankments. Powerful drills bored holes into solid rock at the rate of seven feet an hour. The arms of monster dipper dredges rose and fell from burges afloat in swamps and bays. More than 100 steam shovels doing the work of 10,000 men dug up earth in ten-ton scoopfuls and dumped it into waiting railroad One hundred and fifteen locomotives hauled trains of these cars to the dumps, where a great plow traveled from one end of the train to the other unloading 20 cars, each carrying 60 tons, in less than ten minutes. The earth which was excavated amounted to more than 220 million cubic yards, which would make a line of 63 pyramids, each the size of the Great

THE GIANT LOCKS AT GATUN



This picture, taken while the lock was under construction, gives you a good idea of the tremendous size of the structure. The chamber is 1,000 feet long and 110 feet wide. The gates at the end are 7 feet thick and 76 feet high.



Electric locomotives draw the ships through, thus avoiding the danger of damage to the locks, which would be almost certain if ships were allowed to proceed under their own power. This ship has entered the lock from the Atlantic side, and will be raised to the level shown by the blackened sides of the enclosure before proceeding into the next lock.



Pyramid of Egypt. This earth was used in building the Gatun Dam, in filling in low places, and in building breakwaters for the new port of Balboa created at the Pacific outlet of the canal.

The "Water Stairway" over the Ridge

The French had planned a sea-level canal. The United States called upon a commission of internationally known engineers to study the problem. Upon considering their report, it was decided to leave the

like schoolboys to beat the records of their rivals, Behind the stupendous labors of men and machines stood the skilled planning and calculations of the engineers, which made all parts of the work dovetail together into a smoothly operating enterprise. One man designed lock gates as high as a six-story building that worked with the precision of a fine watch. Another invented a special machine to open and close these giant doors.

OPENING THE SPILLWAY AT GATUN DAM



At the time of its construction, this was the largest cam in the world. It is nearly 1½ miles long measured at the crest, and half a mile thick at the base. At the surface of the water the dam is 400 feet thick. Twenty million cubic yards of material were required to build the dam. The concrete spillway shown in the photograph is 1,200 feet long and 300 feet wide, cut through a hill of rock in the center of the dam. It required 225,000 cubic yards of concrete to build the spillway alone. This spillway allows the surplus water from Gatun Lake to empty out through the Chagres River.

central section of the canal 85 feet above sea level, and to construct a "water stairway" of great locks by which ships could climb up one side of the divide and down the other end.

The French canal's width of only 74 feet would have quickly proved inadequate for modern maritime traffic. The United States plan called for a channel with a minimum width of 300 feet.

It was necessary to make cuts more than 300 feet deep where the canal crossed the Continental Divide. The mountains were blasted away with dynamite in charges that contained as much as 40,000 pounds at a time. The jungle rocked and echoed from the cannonading of this mighty battle of peace.

There was a strong spirit of competition among the workers of the three great divisions—the Central, Atlantic, and Pacific divisions. Strong men worked

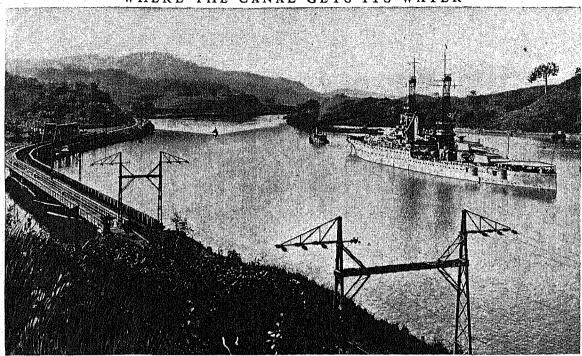
The work progressed in the face of incessant difficulties. Once there was an earthquake. Heavy rains brought terrific landslides in the great Gaillard or Culebra Cut, which often undid the work of months. The Chagres River, flowing down the Atlantic side, was particularly troublesome because of its floods, but it was conquered by the construction at Gatun of one of the mightiest dams in the world, made of earth and rock—a structure a mile and a half long, half a mile wide at the base, and 100 feet wide at the top. This dam connects the hills at each side of the Chagres Valley with a hill in the center, creating Gatun Lake, which has an area of about 165 square miles at normal level.

The Opening of the Canal

So for nearly ten years the digging and dredging and building of concrete walls and locks went on. Then on Oct. 10, 1913, President Wilson, 4,000 miles

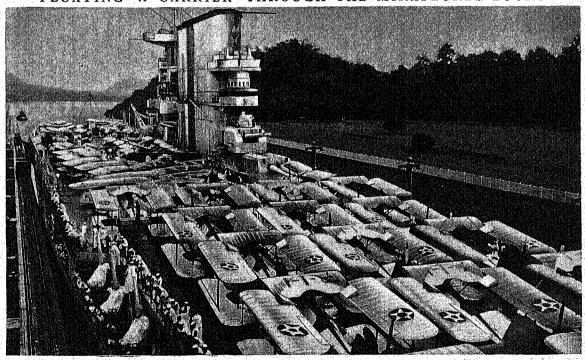
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WHERE THE CANAL GETS ITS WATER



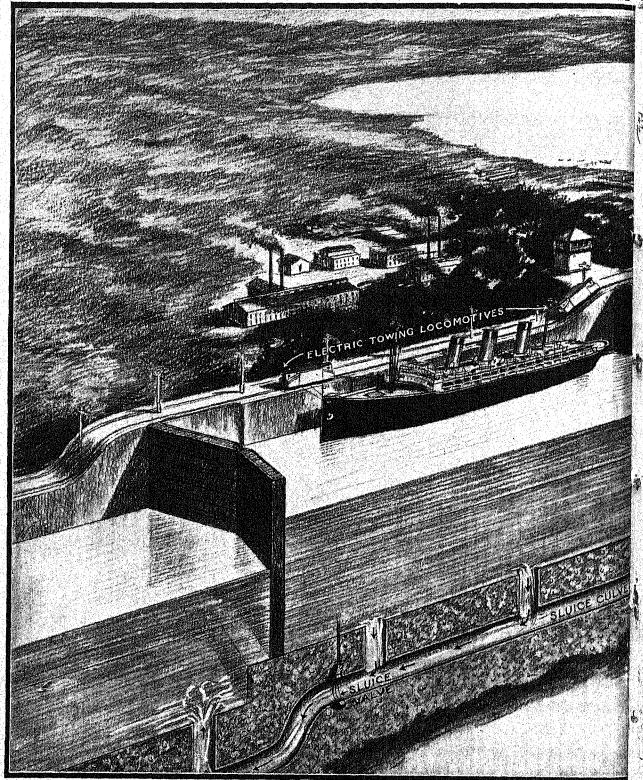
The photographer who took this picture was looking almost directly east, and yet he was facing toward the Pacific. You will see why if you turn to the map on page 52. At the left of this picture is the railway bridge which marks the end of the Chagres River and the beginning of Gatun Lake. It is this river which supplies the vast volume of water necessary to operate the canal.

FLOATING A CARRIER THROUGH THE MIRAFLORES LOCKS



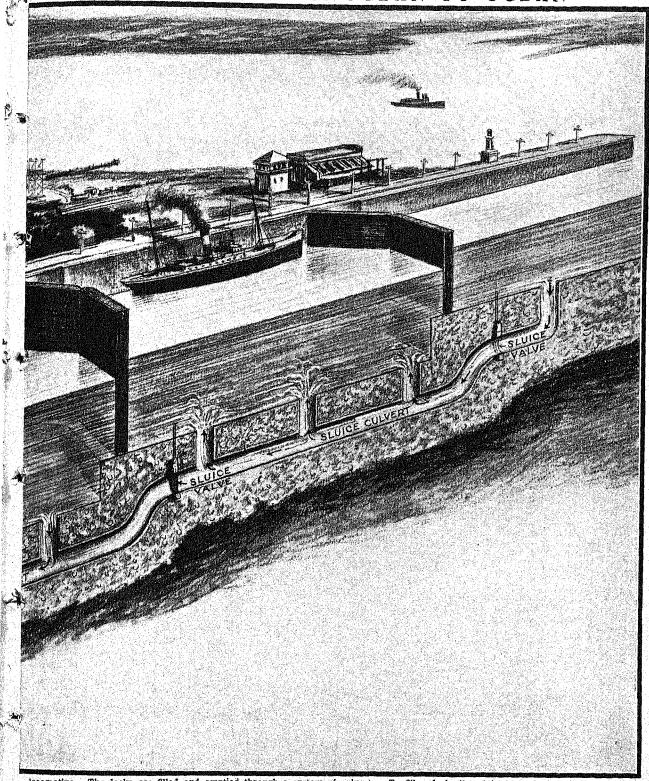
The giant U. S. S. Saratoga, one of the navy's huge airplane carriers, being carefully warped through Miraflores Locks, near the Pacific end of the canal. Although the locks are 110 feet wide and 1,000 feet long, a big ship like the Saratoga has only a few inches of clearance. You can see two of the eight locomotives required to tow it along. Usually four are enough to handle a ship. From this point to the Pacific the route is at sea level.

HOW THE GREAT LOCKS WORK WHICH



This drawing was made so that you could see the principles which are applied in the operation of the Panama locks. All vessels are towed into and through the locks by electric locomotives, which run on cog-rails laid on the tops of the lock walls. For each flight of locks there are two towing tracks, one on the side and one on the middle wall. Usually four locomotives are required: two ahead, one of each wall, to pull; and two behind, one on each wall, to keep the ship in the center of the lock and to stop it when necessary. Each locomotive is equipped with a slip drum and hawser, so that the towing line may be paid out or taken in without actual motion of the

LIFT THE SHIPS FROM OCEAN TO OCEAN



locomotive. The locks are filled and emptied through a system of culverts. To fill a lock, the sluice valves at the upper end are opened, and the lower valves closed. The water flows through the culvert and up through the holes in the floor into the lock chamber. To empty a lock the upper valves are closed and the lower ones opened. The water then flows out of the lock chamber, through the culvert, and out into the lower lock or pool. The main culverts under the walls are 18 feet in diameter, while the smaller ones leading under the lock floor are 3½ feet across, allowing a rapid transfer of water.

away in the White House in Washington, pressed an electric button which sent a flash over wires and cables and set off a tremendous charge of dynamite that blew out a temporary dike. A flood rushed through a rock-walled rift in the mountains, and the Panama Canal was a dream realized! The greatest engineering wonder of the world had been achieved Tolls are charged on a net tonnage basis. The average toll is \$4,500, though the cost may be more than \$15,000 for huge liners. Usually the tolls do not quite meet the expenses of operation.

What is the "big ditch" like today? Imagine you have taken a steamer at New York, sailed down the Atlantic coast, and across the blue palm-fringed

Caribbean Sea to Limon Bay. The harbor is dotted with ships under the flags of a dozen nations. From war vessels to pleasure yachts they take their place in the processions passing into and out of the canal. The Toro breakwater, which extends two or three miles out into the sea as a protection against destructive winds, looms up in front of you, and you steam around it into the canal entrance, where a government

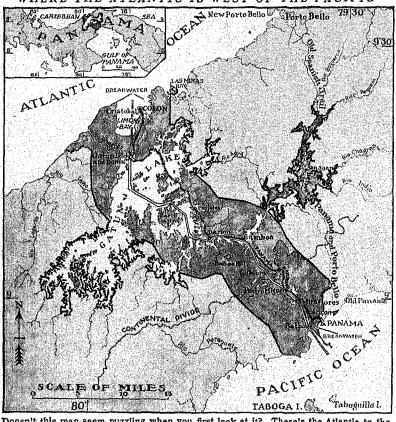
pilot boards the ship.

On your right you see the steelconcrete piers, commissary houses, and hospitals of Cristobal (Christopher), the new port of the Canal Zone; on your left the white houses and red roofs of Cristobal's twin city, Colon (Columbus), which along with Panama City flies the flag of the Panama Republic. Past the great bronze statue of Columbus you sail into the canal across the low coastal belt through a channel 500 feet wide and 40 feet deep, the minimum depth of the canal. The tropical forest has been pushed back, but you see it on each side, with its great ferns, delicate creepers, and brilliantly colored birds and blossoms. The shores begin to rise and the waterway to bore into the hills.

You sail seven miles, and suddenly the way is blocked by an enormous wall of concrete masonry, with a double steel gate in the middle. This is the entrance to the first of the three locks at Gatun. The right half of it opens in two leaves, seven feet in thickness and weighing perhaps 600 tons, and in you sail. Then you see that a central concrete partition, 60 feet wide, resembling a boulevard even to the lamp-posts. divides the canal into two sections, one for incoming, the other for outgoing vessels.

The engines of your ship are stopped, and four electric locomotives on cog tracks on the canal walls -which are 50 feet wide at the bottom and 8 feet wide at top-slowly tow the ship into the lock by hawsers made fast to bow and stern. The gates close behind, shutting the vessel into the great chamber. Each lock is 1,000 feet long and 110 feet wide. From

WHERE THE ATLANTIC IS WEST OF THE PACIFIC



Doosn't this map seem puzzling when you first look at it? There's the Atlantic to the west where the Pacific ought to be. Yet it is perfectly accurate. The Isthmus of Panama, as you can see on the little map in the upper left-hand corner, takes a dip to the southwest at this point. This makes the Atlantic end of the canal actually further west than the Pacific end. The heavy lines indicate the boundaries of the Canal Zone.

by American engineers at a cost of \$375,000,000. The Canal Zone marked the red letter day by placing a new motto on its official seal: "A land divided: the oceans united." On Aug. 15, 1914, the canal was first opened to the commerce of the world.

After 400 years, the explorers' dream of a westward passage had come true. Science and technology beyond Columbus' wildest imaginings, in the hands of a nation then unborn, had built a water highway to speed great, high-powered ships around a world whose size Balboa never guessed.

The total length of the canal, from deep water to deep water, is about 50 miles; from shore line to shore line it is about 40 miles. The passage requires from six to eight hours, and about 48 ships a day can pass through. Between 5,000 and 6,000 ships use the canal in a year, carrying nearly 30 million tons of cargo.

a huge unseen culvert water pours into the lock and your ship slowly rises until it is at the level of the next highest lock; gates open to let you into the next lock. The third lock brings you to the 85-foot level of Gatun Lake, and the engines start again for a run of 24 miles across this great artificial lake.

Through Gatun Lake to the Pacific

Gatun Dam, behind you to the right, holds in the waters of the lake. A spillway with 14 gate-controlled openings lets surplus waters escape into the lower Chagres River. Generators, run by this overflow, supply electric power for operating the machinery of the canal and for lighting the Canal Zone. Farther up the Chagres, and nine miles from the canal, is Madden Dam, which forms another large reservoir built to supply additional water to Gatun Lake and more power for the Zone. It was completed in 1938.

From Gatun Lake you sail into the Gaillard Cut, a great gash through the central divide, more than 300 feet wide at the bottom. Eight miles more and you begin to descend the water stairway. Through one lock at Pedro Miguel the ship drops down about 30 feet to the level of Lake Miraflores, two miles wide; and later two more locks lower you to sea level. From here you can see in the distance the American port of Balboa, on the Pacific side, with oil and coaling plants, dry docks, machine shops, warehouses, and a naval station. A trolley line runs down the coast to Panama City, the gay, quaint old Spanish capital of Panama. Finally you steam eight and one-half miles through a 500-foot channel into the Pacific.

What Does the Canal Accomplish?

This great east-west waterway has been a boon to general world commerce, and of particular value to the commerce of the nations of North and South America. Quicker and cheaper transportation to the markets of eastern North America and of Europe encouraged the development of the rich resources on the western coasts of the New World. Its particular service to nations on the Pacific side of South America has helped to draw closer the bonds of Pan American trade and friendship.

Water distances between Atlantic and Pacific ports of the United States have been more than cut in half. The distance from New York to San Francisco by way of the Strait of Magellan is 13,140 miles; by the canal, it is 5,262. The saving of 7,878 miles amounts to nearly a month's steaming at ordinary cargo ship speed. This saves thousands of dollars in running expense for each ship. Ships traveled 13,551 miles between New Orleans and San Francisco before the canal was opened. Now they travel 4,683 miles.

The canal gives United States ports an advantage in trading with the Orient too. Australia is now nearer to the east coast of the United States than to the north coast of Europe, and Hong Kong is no farther from New York than it is from London.

The benefits of the canal are open in peacetime to all nations of the world on equal terms, in accordance with the Hay-Pauncefote Treaty (see McKinley,

William). To safeguard the canal, the United States may forbid its use by belligerents in time of war.

Its Strategic Importance and Defense

The canal has immense strategic value. Through it the United States can shift its naval strength quickly from ocean to ocean. Since a well-placed bomb could wreck a dam or lock and block the channel, the defense of the canal is a matter of prime importance. Before the second World War, the defenses were already formidable. Guns guarded both entrances. The Atlantic end was protected by a submarine and naval base at Coco Solo, by outlying naval bases in the Caribbean (see Navy), by an army aviation and antiaircraft base at Cristobal, and by an army air base at France Field near by. The Pacific end was guarded by an army air base at Albrook Field.

In 1939 Congress granted large sums to strengthen these defenses and authorized a third set of canal locks. The new construction, begun in 1940, provides locks with a single chamber 140 feet wide, 1,200 feet long, and 45 feet deep. This is big enough to accommodate any ship afloat. They are located a mile or more from the original double-chamber locks.

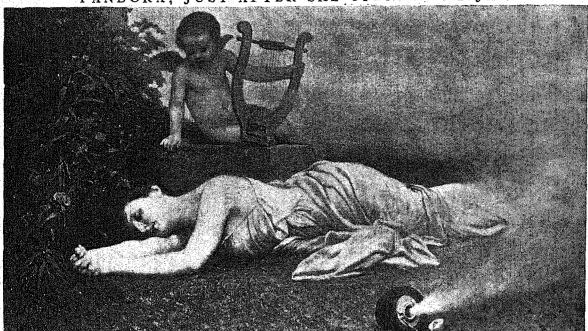
The United States also leased ground for air bases in the Republic of Panama and signed a treaty providing for a trans-isthmian highway between Colon and the city of Panama, which was opened in 1942.

When the United States entered the war in December 1941, the defenses of the canal already reached far out into the Panamanian mainland, and new defenses were completed at unprecedented speed. The jungle concealed air bases, antiaircraft batteries, and listening posts. Two important new air bases near the Pacific were Howard Field, within the Zone, and Rio Hato, 80 miles southwest of the canal. Naval and air bases in the Caribbean islands, leased from Great Britain in 1940, provided for a careful patrol off the Atlantic coast. Similar protective outposts were provided for the Pacific end of the canal.

The Canal Zone. The five-mile strip of land on each side of the canal is a United States military reservation. The government owns all the land and conducts practically all the business. It operates the Panama Railroad which crosses the isthmus, rents property, and runs hotels, stores, a dairy farm, public schools, and many other projects, besides managing the canal. Only a few private companies are permitted. The residents, chiefly canal employees, live cheaply, for prices are low and there are no taxes. Population, both civilian and military (1940 census), 51,827.

PANDO'RA. According to the Greek legend, Pandora was the first woman on earth. When Prometheus (see Prometheus) stole the fire from heaven and bestowed it on mortals, Zeus caused a woman to be made to bring trouble to man. She was fashioned by the artisan-god Hephaestus, and each of the other gods conferred upon her some gift. Aphrodite gave her beauty, Hermes cunning and persuasion, and Athena gave her feminine accomplishments. Zeus sent her to Prometheus' brother, Epimetheus, who gladly accepted her, though Prometheus had cautioned him against her. Pandora brought with her a jar in which were all men's ills and troubles. When the jar

PANDORA, JUST AFTER SHE OPENED THE JAR



After Hephaestus (Vulcan) had fashioned the first woman out of clay, the gods were so pleased with his workmanship that they gave her every charm and made her irresistible. They named her Pandora, which means "all-gifted." Prometheus ("forethought") had warned his brother to accept no gift whatever from the gods, but Epimetheus ("after-thought") was captivated by the beautiful being and made her his wife. Thus he brought misfortune to all mankind.

was opened these escaped and spread over the earth, hope alone remaining. Another story has it that the jar contained all blessings, which would have been preserved for man had not Pandora out of curiosity opened the jar and allowed all but hope to escape. PANSY. What is more charming and pleasing than a bed of these smiling flower faces nodding to you as they sway to and fro in the summer breeze! So roguish are they that it is sometimes hard to realize that they are merely flowers. The name pansy is taken from the French word pensée, meaning "thought," and—

Of all the bonny buds that blow In bright or cloudy weather, Of all the flowers that come and go The whole twelve moons together, The little purple pansy brings Thoughts of the sweetest, saddest things.

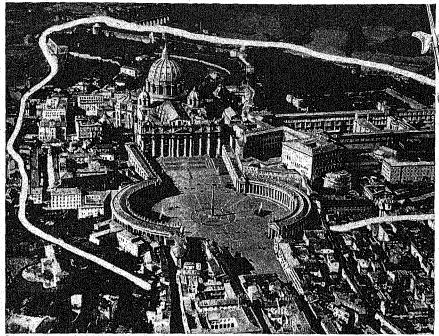
This familiar garden favorite is a cultivated species belonging to the violet family. The story is that some 300 years ago someone carried specimens of the modest little wild flower from the woods to a cool moist place in his garden. There in course of time, by selection and cross-fertilization, the flowers became larger and more brilliant, with rich coloring ranging from white and yellow into orange, dark brown, blue, violet, and purple; and so grew into the pansy of today. Now we may buy the plants and set them out in beds in the garden; but the cheapest way is to buy the seed. Seeds sown under glass in February or March produce plants ready to transplant in May, blooming in July if given proper care and attention.

That the pansy is a favorite with everyone is shown by the quaint names given it such as "Cuddle-me-to-you," "Love-in-idleness," "Heartsease," and many others. Shakespeare immortalized the pansy in 'Hamlet': "There's rosemary, that's for remembrance; pray you, love, remember; and there is pansies, that's for thoughts."

Scientific name of pansy, Viola tricolor. Flowers have five unequal broad petals, five short stamens, five sepals eared at base; leaves long, sharp-pointed, sometimes oval, growing direct from stem; stem slender, one-half to one foot high, with single flower.

PAPACY. The "papacy" means the office of the pope of Rome and denotes the system by which he governs the Catholic church. The word "pope" is the English form of the Latin papa (derived from the Greek papas), meaning "father." The title pope was in early times given to all bishops; later it was restricted to the Bishop of Rome, the patriarchs of Alexandria, Antioch, Jerusalem, and Constantinople. At the present time it is employed by the Roman Catholics solely to denote the Bishop of Rome, who is regarded as the successor to St. Peter, and the chief pastor of the Universal Church. It was apparently in the 4th century that the word pope was first used as the distinctive title of the Roman pontiff. The head of the Roman Catholic church has other titles, such as "Holy Father"; "Vicar of Christ"; "Pontifex Maximus" (literally, "chief bridge-builder," given presumably in imitation of the early Roman emperors, who exercised civil and religious functions); and Servus Servorum Dei ("the servant of the servants

VATICAN CITY, THE SMALLEST STATE IN THE WORLD





The territory within the white line is the papal state formed in 1929 by the Lateran Treaty between the Holy See and the Italian government. It is in the northwest corner of Rome, and St. Peter's cathedral, with its imposing dome, dominates the scene. In front of the cathedral is an impressive plaza, framed by Bernini's Colonnade, and ornamented by an Egyptian obelisk. The Vatican is the square building with the L-shaped wing in the right center of the picture, and, behind it, long wings house the museum and library. Running behind Bernini's Colonnade to the lower right-hand corner of the picture, is the covered passage from the Vatican to the castle of San Angelo (not visible) on the north bank of the Tiber. At the right is one of the picturesque Swiss papal guards.

of God"), which is now so exclusively a papal title that it is found in all official documents such as bulls and briefs.

According to Roman Catholic teaching, Christ in founding the church as a visible institution gave to St. Peter primacy over the other apostles, and made St. Peter his representative on earth by investing him with the three prerogatives of king, priest, and teacher, and bestowed upon him the highest legislative, priestly, and doctrinal authority. The primacy had been promised to St. Peter before the Resurrection, and was conferred when Christ manifested himself to St. Peter and the other apostles on the banks of the Sea of Tiberias. (This teaching is based upon what are termed the Petrine texts, found in Matthew xvi, 17–19; Luke xxii, 32; John xxi, 15–17.)

As the church was to endure till the end of time, Peter must have a successor, who, as Bishop of Rome, should be the Vicar of Christ on earth. History bears complete testimony that from the earliest times the Bishop of Rome has ever claimed the supreme headship of the Roman Catholic church, and that this headship has been universally acknowledged by all within the fold. The pope becomes chief pastor of the church because he is Bishop of Rome; he is not Bishop of Rome because he is chosen head of the church. As head of the church, the pope acts successively as Bishop of Rome, Archbishop of the Roman Province, Primate of Italy, and Patriarch of the Western Church.

In virtue of his position as head of the Roman Catholic church, the pope is its supreme teacher, legislator, judge, and governor. As supreme teacher he formulates what is to be believed by the members of the church, and takes measures for the preservation and the propagation of the faith. He alone can prescribe and regulate its liturgical services. As the supreme legislator of the church he makes laws for all its members, and has full authority to interpret. alter, or abrogate his own legislation or that of his predecessors. As supreme judge the pope can impose penalties either by judicial sentence or by general laws. As supreme governor he has the right of appointment to public ecclesiastical offices, such as the nomination of bishops, the establishment of dioceses, the approval of religious orders, and the authority to impose taxes on the clergy and laity for ecclesiastical purposes.

Though the pope's authority is supreme, it must not be understood that it is either arbitrary or unrestricted. He is directed in the exercise of it by the spirit and practice of the church; by ancient statutes and immemorial customs; by the very purpose of the papacy as expressed by Christ at the time of its institution: "Feed my lambs. . . . feed my sheep" (John xxi, 15-17). The pope is aided in his administration by a number of commissions, tribunals, and offices, collectively known as the Curia Romana. The commissions, known as "Roman Congregations," are 13 in number, each dealing with some special

branch of work; the "Congregation of the Propagation of the Faith," for instance, having supervision of missionary activities; the "Congregation of the Bishops and Regulars" regulating the affairs of religious orders—monks, friars, and nuns. There are two tribunals, one for matters of private conscience and the other for cases between individuals. Appeal from the decisions of the latter may be made to the Apostolic Signatura or supreme tribunal.

Among the offices are the Papal Chancery, which sends out those formal documents issued under the pope's seal called "bulls," (from the Latin bulla, a leaden seal); the Apostolic Chamber, which has charge of finances; and the office of the Secretary of State. This official is perhaps the best known of all representatives of "the Vatican," as the papacy is often called from the place of the pope's residence; for all the political affairs of the church, its dealings with foreign nations, etc., are conducted through him. From his office, also, are issued those less formal public letters, known as papal "briefs." The members of the "Congregations" as well as other chief administrative officers are almost always cardinals (see Cardinals, College of).

The pope has primacy of honor as well as primacy of jurisdiction over all bishops of the church. He ranks first among Catholic princes; is independent of every temporal ruler; and in Catholic countries his ambassadors have precedence over other members of the diplomatic body.

For more than eleven centuries without interruption the pope was a temporal as well as a spiritual sovereign, ruling a district that stretched across central Italy from sea to sea. This territory was known as the Papal States, or the Patrimony of St. Peter. Temporal power was wrested from the papacy in 1870 when the present kingdom of Italy was formed. The popes steadfastly refused to accept this loss of temporal power and remained "prisoners" in the Vatican, until in 1929 a treaty was signed, recognizing the sovereign power of the Holy See over "the City of the Vatican." Even during this period, however, the popes continued to maintain diplomatic relations with most of the nations of Europe and America.

The papacy, with its history of nearly two thousand years, is one of the most ancient of existing institutions. In the registers of the church we can trace the line of Roman pontiffs in an unbroken succession back through the centuries from the present occupant of the papal chair to St. Peter.

As to the manner in which the pope is elected, the method has varied at different periods. In early days the pope was elected by the clergy and the faithful of Rome. At the present day, the election is made by the College of Cardinals assembled in conclave. There are four possible forms of election; the usual form, however, is the "scrutiny," or secret ballot, in which to be successful a candidate must receive a two-thirds vote. (For a list of popes, see the entry "Pope" in the Fact-Index.)

HOW PAPER IS MADE-Its Priceless Value

PAPER. Everywhere we turn we find paper. Our magazines, newspapers, and books are made of paper. In a single year the newspapers of the United States and Canada use enough newsprint paper to belt the earth 50 miles wide. In the form of the standard 73-inch roll this paper would unwind to a

length of 13,000,000 miles. We wrap our bundles in paper. The ice cream soda is served to us at the soda fountain in paraffined paper containers. Our snapshots and all our photographs are printed on sensitized paper. We use paper tablets or writing paper for writing. Tin cans and bottles of medicine and chemicals have paper labels. The walls of our houses are decorated with wall paper. Cardboard boxes are used for countless purposes. The sandwiches which we carry to school or to picnics are wrapped in oiled paper to keep them moist and fresh. It would be difficult to think of life today without paper.

The first paper-makers still ply their trade just as they have done for ages on ages. They are not human

HAT the wire conductor is to electricity, paper is to knowledge—the medium without which its wide conveyance and use would be impossible. Without paper, introduced at about the same time, the invention of printing would have been useless, and the very existence of such a republic as the United States impossible. Without cheap and plentiful paper its citizens, ignorant of one another's thoughts and desires, could never act together. Paper is a bond stronger than steel in the free countries of today. Modern science and invention, too, owe their existence largely to the abundant supply of paper which makes knowledge, as it were, an all-pervasive and life-giving atmosphere.

beings, but wasps; and it is said that a Chinese sage, watching some of these insects build their nest, gained the idea which resulted in the first man-made paper. At all events, the Chinese were making paper in very early times—apparently before the Christian era.

The early Egyptians, 3,000 years or so before

the Christian era, made a writing material from the papyrus plant (from which comes our word "paper") that grewin great profusion on the banks of the Nile (see Papyrus Plant). This papyrus "paper" was made by laying thin slices of the stem with their edges overlapping across other slices at right angles to them. The whole was moistened with water, pressed down, and the rough places smoothed off with ivory or a smooth shell. The slices were glued together, either by the natural gum contained in the fresh stems or by some other adhesive, to form a tough white or ivory-colored sheet, which with age became brown and brittle like the papyrus we see in museums now. Papyrus for documents and correspondence was

exported from Egypt to Rome and Greece, and was so indispensable that a failure of the Egyptian papyrus crop during Tiberius' reign threatened to upset the ordinary business of life in the Roman Empire.

It is said that the failure of a king of Pergamum (which was once one of the greatest cities of Asia Minor) to obtain the papyrus he needed for the enlargement of his library led to a return to the old custom of using carefully prepared skins of goats, sheep, and calves for writing material, and from the new vogue given to this material it came to be called "parchment" (from "Pergamum"). Between the 3d and 7th centuries parchment and vellum (a very fine parchment made of calfskin) displaced papyrus in Europe; the wonderful illuminated manuscript books of the Middle Ages were written on the new materials, which possessed the merits of great smoothness and toughness. These were the only available writing surfaces in Europe until after the

8th century the Saracens carried to Spain the art of paper-making, which they had learned from the Far East.

The spread of the new art was slow and paper did not become common until the 14th century. It grad-

superseded ually parchment and vellum in the 15th century—just in time to establish the usefulness of the new invention of printing: for what would have been the good of a way of multiplying books if the only substances on which they could be printed had been as scarce and costly as papyrus, vellum, or parchment?

Practically any fibrous or cellulosecontaining vegetable material can be used for making paper (see Cellu-

lose). In Asia the bark of the paper-mulberry was generally used. Cotton and linen rags, cleaned, soaked, boiled, reduced to a pulp by beating and grinding, the pulp spread in thin layers and dried between sheets of felt, were the materials most widely

used by the paper-making industry in Europe until the middle of the 19th century. Rag papers, made by hand, sheet by sheet, though far cheaper than parchment, were yet much too costly to render practicable

a modern daily newspaper, with its many huge double sheets to a copy and its edition of half a million copies daily—to mention only one instance of our extravagantly lavish modern use of paper. About the beginning of the 19th century the modern process of paper-making by machinery was invented, and by the middle of the century it had supplanted the hand processes for all but the very finest grades.

Meanwhile all kinds of vegetable fibers were being tried out in papermaking. The huge expansion of the paper-making industry followed on the perfection and general adoption of processes for making print paper from wood pulp, in the second half of the 19th century.

By far the greater part of the world's output is now made from wood pulp. Linen and cotton

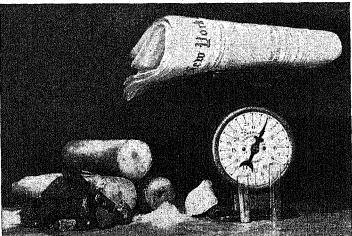
rags and flax waste and sweepings are still used for fine papers. The finest writing papers are made altogether of linen rags, old rags for the softer papers, new linen rags and waste for bond paper. The best tissue papers are made of hemp and rag. Wrapping

papers are made of all kinds of fiberswood pulp, straw, jute, old rope and twine, china grass or ramie fiber, manila hemp (whence the name "manila" paper), and old paper. News-print papers, in countries where wood is plentiful, aremadefromwood pulp; rags, straw, and esparto grass (a Spanish grass largely used in England) are used elsewhere. Most book papers are now made of wood pulp. Feather-



The Hornet knew the secret of paper making ages before men found it out. Here we see one of the Hornet's paper houses. With her strong jaws, the female shaves off tiny particles of wood and chews them up into a pulp. This pulp she spreads out thin layer after layer, and as it dries it turns into a tough springy paper.

ALL THIS FOR ONE SUNDAY PAPER



The scale indicates that this newspaper weighs less than two pounds. Yet more than five pounds of material—shown in the pile at the left—were required for its making. The 3 pounds of spruce wood, I ounce of sulphur, I ounce of bleaching powder, 1½ ounces of unslacked lime, and the red and blue dye are converted into enough stock for one newspaper by about 2 pounds of coal.

weight papers are made of esparto. Bamboo fiber is an important new source of book paper.

Wood pulps are divided, according to the processes by which they are made, into mechanical or ground pulps and chemical pulps, the latter including pulps made by the sulphite, soda, and sulphate processes. The soda process is used for poplar, basswood, beech, and other soft deciduous woods, while the grinding, sulphite, and sulphate processes are used for coniferous woods. Whichever the process, the logs (usually from trees 10 to 12 inches in diameter) are cut in 2-foot

lengths, barked, and trimmed to remove knots, seams, and decay.

To make ground pulp, the blocks, placed in steel pockets against a revolving grindstone, are held firmly by hydraulic pressure, while water playing on the stone carries away the ground fiber. The pulp in the water is then strained through vibrating screens to remove lumps, and, if necessary, bleached. In some pulp mills the pulp is at once made into paper; in others it is formed into sheets for sale to the papermakers.

To make chemical pulp, the log sections are chipped up and placed in a "digester," where they are cooked for a number of hours in a chemical solution—caustic soda in the soda process, acid sulphite of calcium and mag-

nesium in the sulphite process, and sodium sulphate (which becomes sulphide) in the sulphate process.

There is considerable difference in the quality of the fiber obtained by the different processes. Ground pulp and soda pulp have little strength, but are useful to supplement stronger fibers. Sulphite pulp and sulphate pulp, especially the latter, make strong, tenacious paper. News-print paper is made of a mixture of ground pulp and sulphite pulp.

The Making of Paper

The real making of paper begins in the "beater," a huge oval tub furnished with a revolving horizontal roll set with knives like a paddle wheel. The quality of the paper depends on the material furnished the beater, the length of treatment (10 to 12 hours for linen bond, one and a half to three hours for cheap printing papers, and one to one and a half for soft cotton fiber for blotting paper), the character of the knives, and other features of the machine. In the beater, a mineral "filler" (usually china clay or sulphate of lime) or starch is often added, to fill the pores and give weight to the paper. Dyes and rosin or aluminum sulphate sizing are added if desired. The size forms a coat of varnish on the fibers, making the paper less absorbent and less transparent.

From the beater the pulp or "stock" ordinarily passes through a "refining engine," in which it is

still further mixed and beaten. The most common type consists of a cone set with knives revolving in a stationary conical case, the inner surface of which is likewise set with knives, the stock flowing between the cone and the case. It is then screened, thinned, and pumped to the paper machine proper.

READING "CHARACTER" IN PAPER

An expert can quickly determine the quality of paper. He reduces the sample to a pulp, treats the fibers with a chemical solution to dye each variety of fiber a different color; then when they are magnified under a microscope, as shown above, the shape and markings of the fibers tell him the whole story. For instance, the dots and lines on these fibers together with their color tell the expert that the paper was made of spruce wood by the sulphite process.

the the stock flowing between It is then screened, thinned, r machine proper.

The Fourdrinier machine, on which book, news, and writing papers are made, is the same, improved yet essentially unchanged, as that which revolutionized

paper manufacture more than a hundred years ago. In this machine the liquid stock flows out on an "apron" of waterproof cloth by which it is spread over an endless belt of fine wire cloth, 60 to 100 feet long, woven with 60 to 90 meshes to the inch. traveling horizontally over many small rollers, through which the water immediately begins to drain away. The belt is given a sidewise shake as it runs, so as to felt the fibers crosswise as well as lengthwise. For news-print the belt may be wide enough to make paper 200 inches wide, running 500 feet or

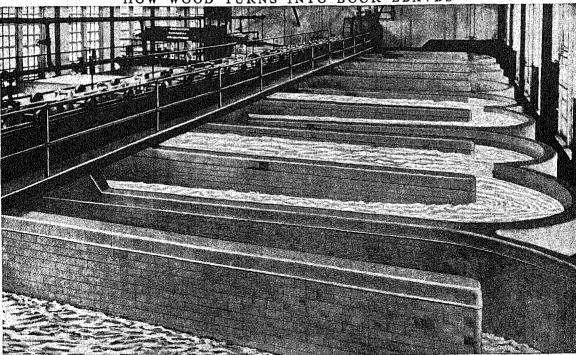
more a minute. For book and writing papers the width is from 60 to 150 inches and the speed 60 to 400 feet a minute. "Wove," "laid," and "watermarked" papers, before leaving the wire belt, pass under a light wire roll called the "dandy," which impresses the proper design upon the paper. For wove paper the dandy has the same number of wires as the belt below. Laid paper has parallel lines about an inch apart crossed at right angles by

lines quite close together.

From the wire belt the still moist tender web of paper passes, supported on a belt of felt, through two or three pairs of massive press rolls. From these it runs alternately over and under a number of steamheated metal cylinders, the "driers." Fine papers may receive at this point a "tub" sizing in a vat of gelatin solution. Next the paper passes through the "calenders," a stack of chilled iron rolls which smooth it, producing a "machine finish." It is then wound on a reel and passes to the "slitter," which trims the rough edges and, if necessary, cuts the roll into two or more narrower ones. News-print is now ready for the printing press. Fine papers for some kinds of book and magazine work may be "supercalendered," or given a hard smooth finish in a supplemental calendering through alternate chilled iron and paper rolls under great pressure; or they may be "coated" with glue or

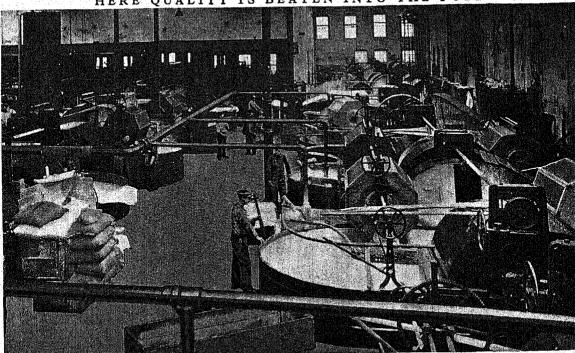
(Continued on page 61)

HOW WOOD TURNS INTO BOOK LEAVES



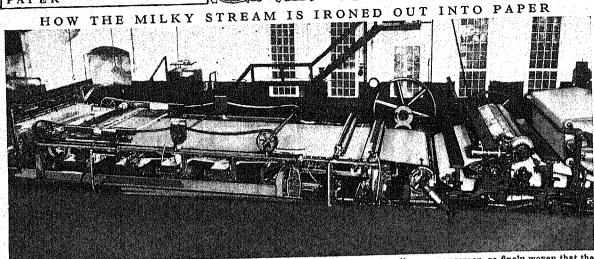
First, the logs are cut up into small chips by revolving knives. The chips are then "digested" by chemical solutions in steam-heated tanks and come out as a thick creamy mass which flows through the "bleachers" shown here. Bleaching powder turns the pulp white, after which it is washed and prepared for "heating."

HERE QUALITY IS BEATEN INTO THE PULP

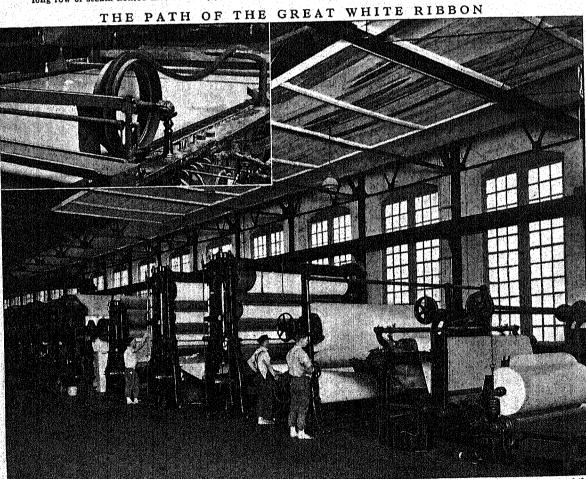


Let us visit a modern "beater" room, where the actual making of paper begins. The sacks at our left contain china clay, which fills up the pores of the paper. Other containers are filled with sizing, used for hard finish stock, and with coloring matter, for making up the pores of the paper. The pulp is piped into the oval beater vats and mixed with the necessary amount of clay and other ingredients. A tinted paper. The pulp is piped into the oval beater vats and mixed with the necessary amount of clay and other ingredients. A revolving paddle wheel, having knives for its paddles, further separates the fibers while it mixes the ingredients. The longer the beating the better the paper.

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Flowing through a strainer into the "head box" at the left, the pulp spreads out on an endless copper screen, so finely woven that the fibers remain while the water drains off. This screen moves forward with a side-to-side motion, which settles the fibers and knits them together. Look at the first roller toward the right; it is a suction roller, and extracts excess water as the pulp passes over it, them together. Look at the first roller toward the right; it is a suction roller, and extracts excess water as the pulp passes over it, them together. Look at the first roller toward the right; it is a suction roller, and extracts excess water as the pulp passes over it, them together. And here real paper begins to appear. The The moist fibers now advance between blankets of wool felt to a series of brass rollers. And here real paper, then pass it on between a rollers squeeze out the remaining moisture and incorporate the fibers into a continuous sheet of paper, then pass it on between a long row of steam-heated metal rollers, pictured in the lower photograph, which dry and harden it as it progresses.



If you were to start from the wet end of the machine, shown in the upper left-hand corner, and leisurely walk the length of the machine, you would be keeping abreast of the same mass of pulp, and you would learn how really short a time it takes for the marvelous Fourdrinier machine to iron the milky stream out into beautiful fine-textured paper such as you see in the large photograph.

casein and china clay or some other mineral which gives a smooth surface, but softer than that of supercalendered papers. Glazed papers of the type used for covering paper boxes are given a very glossy finish by calendering in a machine where a top roll of hot iron revolves much faster than the roll below.

Cardboard, strawboard, binders' board, building board, heavy papers, and most tissue papers are made on various modifications of the Fourdrinier machine. In one of the most important of these, known as the cylinder machine, the wire cloth is fastened around a cylinder which revolves in the vat of pulp stock, taking up a layer with each revolution. Machines for making heavy boards are so arranged that the sheets from several cylinders meet and are pressed together as they leave the wire cloth.

Several billion pounds of newsprint, besides other paper, are used each year in the United States. The nation's demand for paper has threatened to deplete its northeastern forests of spruce and fir, and has necessitated huge and costly imports of newsprint, wood pulp, and pulpwood from Canada. Hence the United States is seeking new sources of paper at home. Cornstalks are a possible source, but have yet to prove commercially practical. Far more promising are the South's millions of acres of pine, which has been used in large-scale production of kraft paper since 1920. In 1933 Charles H. Herty, a Georgia chemist, created a new outlet for Southern pine by proving that it makes satisfactory newsprint.

Lignin or sulphite pitch, a by-product of the sulphite and sulphate paper and pulp mills, is now used in a spraying solution to rid orchards of insect pests. It is also used as a spreader and sticker for a dry-mix sulphur-lime fungicide. (See Spraying.)

The very thin, tough, and opaque paper called "Bible paper," the best known type of which is the Oxford India paper, is made of linen rags with starch or minerals added to give opacity. The very strong translucent "parchment paper" used to protect the corks of toilet preparations and for other purposes is made by dipping ordinary unsized paper into sulphuric acid and quickly washing out the acid. "Waxed paper" is passed through a machine that coats it with melted paraffin. Most so-called "rice paper" is not, properly speaking, a paper but a natural tissue derived from the pith of a small Formosan tree; and it has nothing to do with rice. It is used for the manufacture of artificial flowers, for the painting of small pictures, and for the manufacture of sun hats. But paper made from rice straw is also called "rice paper."

Kraft paper is a very tough dark-brown paper made by digesting wood chips by sodium sulphate. It is much used for making heavy sacks for grain and flour, for wrapping paper, and for a sort of twine made by rolling in narrow strips. Roofing and building papers are made from all sorts of coarse and cheap materials, usually impregnated with asphaltic substances.

In the United States most newsprint is made in rolls from 30 to 75 inches in width. Sheets for writing, ledger, and book work were formerly made in a great variety of sizes, with consequent waste. Now only a few standard sizes are made, except on special order. Sizes are designated in inches. In former practise each ordinary size had its trade name, such as: foolscap, 18 x 16; cap, 14 x 17; crown, 15 x 19; demy, 16 x 21; folio, 17 x 22; royal, 19 x 24; elephant, 23 x 28; columbier, 23 x 34; antiquarian, 31 x 53.

PAPIER-MÂCHÉ (pā-pyā' mā-shā'). When paper pulp mixed with glue, paste, oil, rosin, or other sizing is dried in a mold under pressure, a tough plastic product resembling wood results. This is called papier-māché, which is French for "pulped paper." If you look around your home you will doubtless find that many common articles are of papier-māché—boxes, vases, trays, lacquer ware, light articles of furniture, architectural adornments, and numerous household utensils, such as pails and tubs. Its most important use is as a mold for the stereotype plates from which newspapers are printed, though it has been used for many other purposes, including doors and car wheels.

In addition to the kind made directly from paper pulp, papier-mâché is also made from sheets of thick millboard, which are heavily pressed, and from sheets of paper. In making this last kind, a number of sheets are saturated with water, and then pressed into a mold. The articles thus formed are then dried by heat and dipped into a mixture of linseed oil and tar, then baked, trimmed, planed, and painted with several coats of tar and lampblack. Finally, they are varnished, lacquered, and polished ready for the market.

PAPINEAU (pä-pē-nō'), Louis Joseph (1786–1871). From the year 1808, when he entered the assembly of Lower Canada (Quebec), until 1837, when he fathered a short-lived and disastrous revolt of French Canadian peasants against British rule, Louis Papineau was the stormy petrel of Lower Canada politics. His aim was not merely a reform of the existing government, which then gave the British minority a monopoly of offices and power, but perhaps also the complete independence of French Canada.

As speaker of the assembly for nearly the whole of this period, Papineau was a continual thorn in the side of the council and the British governors, one of whom resigned (1827) rather than confirm his election to the speakership. By his fiery eloquence he fanned the flames of racial suspicion and hatred between French and English in Lower Canada. Matters at last came to a head when the assembly for several years refused supplies to the governor and other officials, as a means of forcing the government to make the legislative council elective. When this concession was denied, there was an outburst of resentment which culminated in 1837 in a series of risings by the "Sons of Liberty," as the revolutionists called themselves. But the soldiery made short work of the poorly armed and unorganized peasants, and Papineau saved himself by fleeing to the United States, where he remained for two years, and later to France.

After the amnesty of 1847, Papineau returned to Canada. He was elected to a seat in the then united parliament, and again continued to agitate for the separation of Upper and Lower Canada. But the idol of the French Canadians had fallen; Papineau's influence was gone, and he soon retired to spend the remainder of his long life in seclusion.

PAPY'RUS PLANT. In ancient times the reed called papyrus (Cyperus papyrus) was widely cultivated in the Delta of Egypt. It was used for many purposes, especially for a species of paper prepared from the pith. The reed grows from three to ten feet high, with long sharpkeeled leaves, and soft naked stems as thick as a man's arm at their lower part; it is topped by numerous long drooping spikelets. The more slender stalks were woven into baskets, and the thicker ones, tied into bundles, were made into light boats. The fiber furnished material for cordage, sails, awnings, and matting. The pith, besides being used for paper, was eaten raw or boiled by the poorer classes. The root was dried and used for fuel and in the manufacture of utensils. The papyrus plant is now extinct in Lower Egypt, but still grows in the Upper Nile regions and in Ethiopia. (See Paper.)

PAR'ACHUTE. Hold an open umbrella high above your head and try to pull it down quickly. You will find it difficult because the air offers so much resistance. This is the way a parachute acts. It uses the resistance of the air to ease the descent from an airplane or balloon. Parachutists have landed safely from heights of more than six miles.

Parachutes are made with the utmost care. While cotton may be used, the fabric for parachutes is us-

ually light-weight silk specially woven with long fibers to give it strength and elasticity. The silk is left raw, that is, untreated, so that it will not crease. About 36 shrouds or lines of strong silk cord are evenly spaced around its circumference and connected to a harness that is strapped around the jumper's body.

The standard parachute is 24 feet in diameter, and packs into a bundle 18 inches square by 4 inches high, weighing 18 pounds. The packing must be done very carefully so that the lines will not become twisted. Attached to the top of the parachute is the little pilot 'chute,

about three feet in diameter and equipped with ribs and springs of steel that force it open the instant it is released. The parachute pack is often so arranged that its wearer can sit on it, using it as a cushion. The pack itself is held together by two pins running through slots in its outer covering. Attached to each pin is a strong flexible steel cable, or rip cord, which is connected to the release ring on the jumper's left side. To open the parachute, the jumper pulls this ring, thereby drawing the pins out of the slots. The

flaps of the bundle fly open and the little pilot 'chute pops out, opening instantly. This drags after it the big parachute, which opens almost immediately and checks the fall. A vent in its top allows some air to escape upward and thus tends to steady the course of the descent. This course can be altered by manipulating the shrouds. For example, if the jumper pulls down the shrouds on his left, air spills out from under the right side of the canopy, and the whole parachute slants off to the left.

Parachutes are used to enable fliers to escape from disabled airplanes, or to drop medical or other supplies to persons marooned on ice-blocked ships, in snowbound territory, or in otherwise inaccessible regions. Fire fighters of the United States forest service sometimes make use of them. Protected by fireproof clothing, they land as near the fire as possible. Then a kit of fire-fighting tools is dropped to them by another parachute. In wartime, the parachute is used as an important offensive weapon. "Parachute troops," and their ammunition and other supplies, are dropped at strategic points within the enemy's territory.

PARADISE BIRDS. The brilliance of the rainbow is mirrored in the plumage of the birds of paradise. The early Dutch explorers, the first Europeans to see

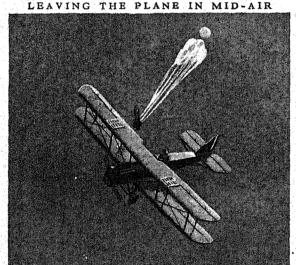
these birds alive, believed them to be fed from the dews of heaven and the nectar of flowers. They thought that these tropical birds of Australasian regions lived entirely in the air. As proof, they displayed two cured skins of the birds, given them by the natives. From these skins the wings and feet had been so skillfully removed that the great naturalist Linnaeus himself did not detect the trick. for he named the principal species the apoda, that is, the "footless" birds. We know now that these birds are really related to

the common crow.

There are about 50 species of birds of para-

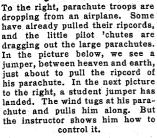
dise, all confined to the tropical islands of the western Pacific and northern Australia. The size of their bodies ranges from that of a crow to that of a sparrow, and each species has its own characteristic pattern of brilliant feathers.

The "great emerald" paradise bird is a changeable purple beneath, with head and neck of pale yellow, and forehead, cheeks, and throat of metallic green. Beneath his wings are tufts of delicate golden-orange feathers, which when the wings are raised fall over

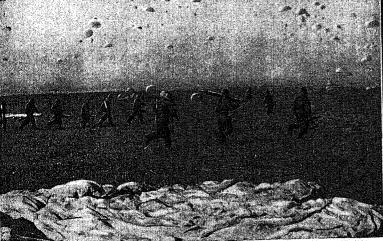


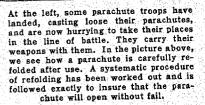
To test this parachute, the jumper climbed out on the wing and pulled his rip cord. The little pilot 'chute has dragged the big parachute out of his pack, and he's off!



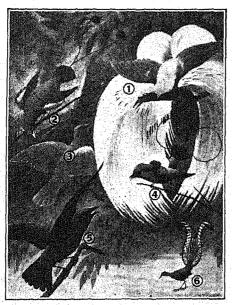








AMONG THE BIRDS OF PARADISE



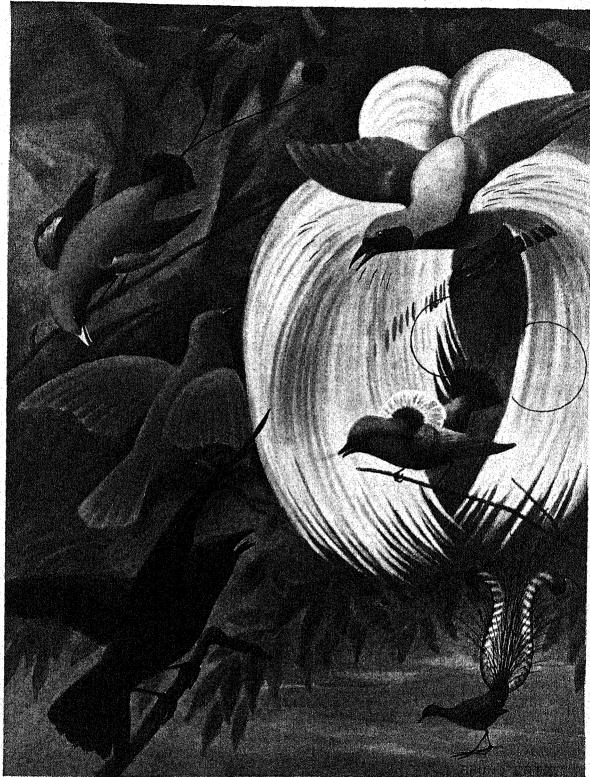
KEY TO COLOR PLATE

OST brilliant and showy of all birds are the many species usually grouped together as "Birds of Paradise." They live in the East Indian island of New Guinea, on near-by smaller islands, and at points on the adjoining north coast of Australia. Only the males have the fine plumage, which they show to gorgeous effect in "dancing parties," held in the mating season. Whether the plumage serves merely to win the favor of their mates, or thereafter serves a more lasting purpose in drawing natural enemies away from the nests and the plainly colored mother

bird and young, is a point undecided by naturalists. The plumage, however, has nearly proved fatal to many species not widely distributed; for natives attend the "dancing parties" and shoot the males with blunt arrows so their valuable feathers will not be injured.

The Great Bird of Paradise (Paradisea apoda) is shown on the opposite page (1). His most striking feature is the great array of fine plumes springing from beneath the wings. He is being viewed with admiration by his plainly colored lady (3). These birds are found particularly in the Aru Islands, adjoining New Guinea. With them in the picture we see a King Bird of Paradise (2) and a Magnificent Bird of Paradise (4).

Curiously enough, the Crow down there in the corner (5) is a close relative of the Paradise family, far closer, indeed, than the Lyre-Bird (6), despite the fact that the latter would seem more suited to this gorgeous company. The Lyre-Bird dwells in Australia and like so many other animals of that continent is a primitive type, despite his elaborate trappings. Unlike the Birds of Paradise he is a capable singer.



Painting by Bruno Ertz

See text on opposite page

AMONG THE BIRDS OF PARADISE

The attist has included in his picture three species of the paradise birds, a lyre-bird, and, by way of contrast, a common black crow. Read more about this colorful assemblage on the facing page,

him like the spray of a fountain. The "red" paradise bird has similar tufts of crimson and, in addition, curling tail feathers 21 inches long. The "superb" paradise bird has on his neck a feather-shield which he can spread about his head, in a fanlike circle.

During the mating season, the male birds congregate, as many as 20 in one tree, and show off their fine feathers before the females. Though they are usually wary, the birds are now so interested in their "style show" that hunters may shoot them at close range. After mating, the female lays two or three eggs in a nest in a tall tree, and takes entire care of the young when they have hatched.

Bird-of-paradise feathers used to be in demand for hat trimmings, but their importation into the United States has been forbidden. Other countries also discourage the slaughter of these handsome birds.

Scientific name of great emerald bird of paradise, Paradisaca apoda; of the red, Paradisaca rubra; of the superb, Lophorhina superba.

PARAFFIN (păr'ā-fin). This white wax seals jelly glasses, waterproofs matches, protects monuments and buildings, and serves many other purposes (see Wax). Cleopatra's Needle, the Egyptian obelisk in Central Park, New York City, has remained weatherproof ever since it was treated with melted paraffin in 1885. Paraffin is obtained by distilling petroleum, shale, coal, or wood. Most of the paraffin of commerce comes from petroleum (see Petroleum).

PARAGUAY (pār'ā-āwā). With its excellent soil, favorable climate, and other advantages, Paraguay could support a population of perhaps 40 million people. Yet it has the smallest population (about a million) of all the South American republics, and the smallest foreign trade, and it is the least visited by foreigners.

Its tragic history goes far to explain Paraguay's lag in progress. When it threw off the rule of Spain in 1811, it fell into the hands of a series of dictators who ruled it with a rod of iron until 1870. The first

of these, José Gaspar Rodriguez Francia, exercised a personal despotism (1814–40) almost without parallel in modern times. He imprisoned, flogged, and executed his subjects at will. He made Paraguay virtually a closed country, and almost completely ended foreign trade. Francia's nephew, Carlos Antonio López (1844–62), opened the nation to the outside world and set on foot some wise reforms.

But the third of the despots, Francisco Solano López (1862–70), son of Carlos López, plunged his country into a war with Argentina, Brazil, and Uruguay that lasted five years. The Paraguayans fought with such desperate heroism that two-thirds or more of them died. Even today the women outnumber the men, and the country has never recovered from this frightful conflict.

The country is further handicapped by its isolation. It is the only South American nation except Bolivia that does not lie on the ocean. The capital, Asunción, is 950 miles north of Buenos Aires. To reach it travelers from Buenos Aires must take a train ride of more than two days or a steamer trip of four days, unless they travel by airplane.

The Land and Its Climate

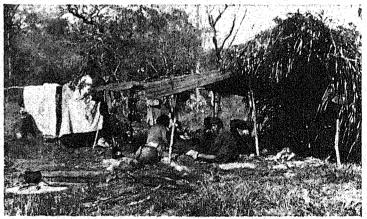
Paraguay is about the size of California, with an area estimated at 155,000 square miles. (For map, see Brazil.) One-third of it is in the tropics; its southern two-thirds is in the middle latitudes. The Paraguay River divides it into two distinct regions.

The eastern part, sometimes called Paraguay proper, lies between the Paraguay and Parana rivers. Most of the people live in this area of about 62,000 square miles. This region is, for the most part, rolling and hilly. Through its center runs a broken line of highlands, nowhere more than 2,200 feet high. In the low, partly swampy, plain which slopes west toward the Paraguay are most of the farms and cattle-grazing lands. Nearly half of it is forest-covered with tropical hardwoods. The region that slopes east to the Parana is a subtropical wilderness, mostly forested. Its wild yerba trees for centuries have been the source of the national drink, yerba maté, or Paraguay tea. These holly-like trees are also cultivated on large estates. The Guaira Falls of the Alto (Upper) Parana are the country's most beautiful scenic attraction.

The remaining three-fifths of the country, west of the Paraguay, is part of the vast expanse of grassland and forest called the Chaco (see South America). Some Indian tribes live here, and a handful of immigrant colonists have started ranches and farms; but most of the Chaco is uninhabited and unexplored. Quebracho ("ax breaker") trees along the west bank of the Paraguay River furnish both a valuable tanning material and tough, durable wood used for railroad ties.

The climate is tropical or subtropical. In the summer (November to April) from about 30 to 40 inches

INDIAN LABORERS IN THE WILDS OF PARAGUAY



Indians employed in cutting quebracho logs in the Chaco region live in temporary huts as pictured here. The jug in the foreground is probably used for brewing yerba mate, or Paraguay tea, the favorite national drink.

of rain fall in Paraguay proper, and in the winter, from 20 to 30 inches. Dry winds from Brazil frequently bring droughts to the Chaco in winter. Cold winds from the south occasionally break the extreme summer heat.

The People and Their Cities and Farms

The people are chiefly of mixed blood. They are descendants of the Spanish settlers and Guarani Indian tribes. There are only a few pure-blooded Indians today, most of them living in the Chaco; and still fewer people of pure Spanish blood. Paraguay encourages immigrants but is too remote to attract them in numbers. Colonies of Mennonites from Canada and the United States have settled in the Chaco.

Guarani is spoken more widely than Spanish, the language of business and state. Schools are few in the rural areas, and at least two-thirds of the people cannot even read and write. There is a university at Asunción. Roman Catholicism is the state religion. Health and sanitation have been improved in recent years, but tuberculosis, typhoid fever, and malaria take many lives, and hookworm saps strength.

Most of the people live on small farms or large cattle ranches. Their chief field crops are corn, beans, sweet potatoes, rice, manioc, tobacco, oranges, and bananas. Their implements—the ax, the hoe, and the machete (a long, heavy knife)—are crude. Cotton and sugar-cane growing are increasing; much of the sugar is made into rum. The manioc, or cassava, a starchy tuber, is the bread and potatoes of the people (see Tapioca). On every little farm there are fowl and cattle. The Paraguayan cowboys, called chacreros, herd millions of cattle on the great ranches. Farm and village houses are usually of adobe with palm-thatched roofs. Each house has a covered lean-to where hammocks are swung.

Asunción, the capital and only large city, is situated on a high bluff on the Paraguay River opposite

the mouth of the Pilcomayo. Other cities are Villarrica, in the richest farm region; Encarnación, on the Paraná River; and Concepción, on the Paraguay.

The Paraná-Paraguay river system is a great highway of travel and trade. Vessels of 12-foot draft can reach Asunción. In addition to the main railroad to Buenos Aires, there are a few short lines running inland from the Paraguay River. The total railroad mileage is only about 700 miles. Most roads are mere trails over which oxcarts rumble.

Paraguay is largely self-supporting. The small foreign trade is mostly with Argentina, Germany, Great Britain, the United States, Japan, and Italy. The chief exports are cotton, quebracho extract, hides, beef extract, yerba maté, tobacco, and petitgrain oil (a perfume base distilled from bitter orange leaves). Manufactures are little developed, and foodstuffs, textiles, and machinery are imported. Mining, too, has made no progress, although there are deposits of iron, manganese, copper, mercury, and other minerals.

Chief Historical Events

A Portuguese, Alejo Garcia, crossed this region about 1524, and in 1526 Sebastian Cabot sailed up the Paraná-Paraguay rivers to claim the land for Spain. Asunción was founded in 1537 by Spaniards seeking a route to the silver mines of what is now Bolivia. Jesuit missions dominated the country from 1610 until 1769, when they were expelled. The Jesuits introduced orange trees and other plants, as well as cattle, and taught the Indians better farming methods.

Independence from Spain was declared in 1811. After the devastating Paraguayan War (1865-70), a constitution was adopted, based on that of the United States. But civil wars were frequent and in 1932-35 a war with Bolivia was fought over the long-disputed ownership of the Chaco region. It was not until 1938 that the two countries came to terms and a boundary was established (see Bolivia).

In 1936 army leaders set up a military dictatorship. Three stormy years followed in which two governments were over-thrown. In 1939 the Chaco hero, Gen. José Felix Estigarribia, became president in the first election held since 1932. After his death in 1940, Higinio Morinigo, the provisional president, assumed dictatorial powers.

"LOAFERS" of the ANIMAL and PLANT WORLDS

PARASITES (păr'ā-sīts). The parasites of the plant and animal worlds live by attaching themselves to other plants and animals and feeding upon the bodies or food supplies of their hosts. The name parasite comes from a Greek word meaning "one who dines at another's table." It is applied to shiftless human beings as well as to parasitical plants and animals.

A considerable proportion of both plants and animals lives partly or entirely by attaching themselves to other living things. All living animals, great or small, are liable to the attacks of the unwelcome visitors. Man is no exception. More than 150 distinct species of parasites may infest his blood, muscles, glands—in fact, almost every organ and tissue in his body. The most dangerous of human parasites are the disease-producing germs, which are responsible for such deadly ills as tuberculosis, malaria, diphtheria, typhoid, and sleeping sickness (see Germ Theory of Disease).

The number of parasites harbored by one host may be enormous. Several million have been found in a single horse. About 40 different kinds of parasites infest the dog; cattle and pigs have more. At least 20 kinds of parasites accompany the frog on his watery way. Even the great thick hide of the rhinoceros does not protect him from the tick. Birds and quadrupeds, fishes and whales, even insects, are all the unwilling hosts for myriads of smaller creatures. You remember the old rhyme:

'Tis said that fleas have lesser fleas Upon their backs to bite 'em, And these in turn have lesser still, And so ad infinitum.

Even the tiny protozoa, the one-celled animals so small that we can see them only by the aid of a highpowered compound microscope, have smaller protozoa living on them.

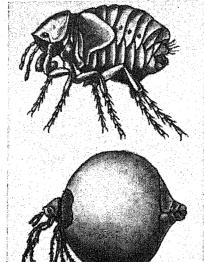
We are all familiar with certain kinds of parasites. The famous "cooties," or body lice which infested soldiers during the World War. often conveying the germs of typhus fever, are good examples. So too are the many other kinds of lice that live upon the bodies of man and other animals, and such insect pests as the jigger or chigger (a mite which attaches itself to the skin), mosquito, and bedbug. The parasite usually gets not only its food from its host, but also warmth and protection as well. And the parasite usually does nothing for its host in return. In fact it often injures its host, and if present in great enough numbers actually causes its death.

Parasites live on the outside of the bodies of plants and animals, and very often inside as well. Examples of external parasites are the lice, fleas, and ticks of animals, and the plant lice and scale insects of plants. Some

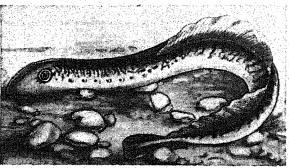
scale insects of plants. parasites live for their whole lifetime on the body of the host. Such parasites are called permanent parasites. The bird lice are permanent parasites. Their eggs are laid on the feathers of the birds, and the young descend to the skin when they hatch. But fleas are of a different sort. They often leap off from the body of the host, and

may even go to some other host. Such parasites are called temporary parasites.

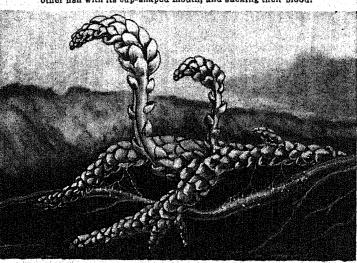
Some of the internal parasites most familiar to us are those that live within the human body. The most common of these is the tapeworm. It lives in the intestines and eats the food which ought to go to nourish the person. Too many of these may cause death. The hookTHREE UNDESIRABLE GUESTS



This is a type of South American flea called a "Chigoe" or "Jigger," before and after it has burrowed under the human skin. The same name applies also to a mite, common in the United States, whose bite causes persistent itching.



The Lamprey is one of the worst of parasites, clinging to other fish with its cup-shaped mouth, and sucking their blood.



The Toothwort not only attaches itself to the roots of other plants but kills and digests small insects which venture to explore its leaves.

worm and trichina are other internal parasites of man which cause disease (see Hookworm; Worms).

It often happens that the young of certain animal parasites are provided with a full outfit of legs, but soon they settle down and lose their legs. The legs are absorbed just like a pollywog's tail when he turns into a frog; and so during the rest of its useless life the parasite just sits attached to its host and cats and eats, and finally lays its eggs and dies.

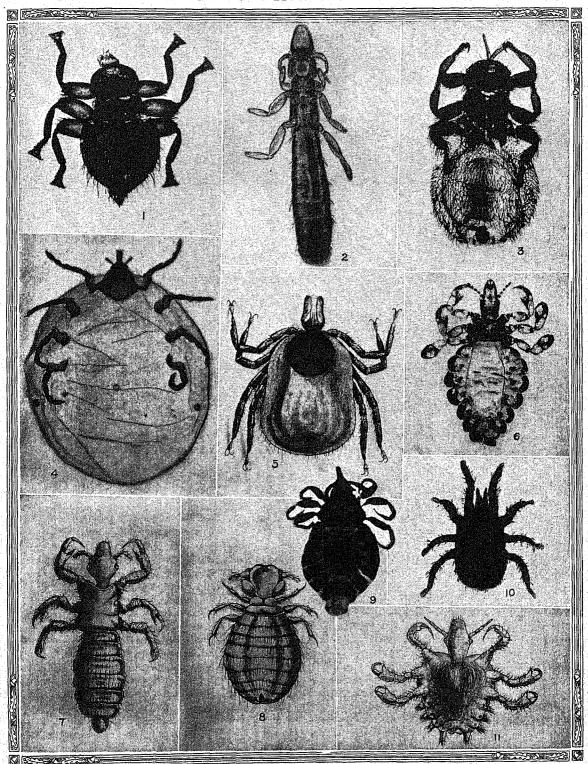
The sacculina, which lives attached to certain kinds of crabs, is one of this kind of parasite. Not only does this creature lose its legs, but everything else that would make it look like an animal, and becomes a mere bag for holding nourishment, and a series of branches to penetrate the crab's body and suck its

juices up. Such a loss of parts is called degeneration.

All internal parasites are greatly degenerated. You might say that they have shirked the struggle for existence, seeking a sheltered and easy life on the lowest possible terms; and so, according to the law of nature that an organ or function which is not used is lost,

they have lost many powers which their ancestors once had. Many parasites which live firmly attached to their hosts have no legs or wings; and since they do not need to see their way about or watch out for food and enemies, they have also lost their eyes, ears, feelers, and other sense organs, Their food is pre-digested by their host, and so they have very simple alimentary

SOME PARASITES THAT PREY ON ANIMALS



Here are some of the well known external parasites that get food and shelter at the expense of other animals. They are all greatly magnified. No. 1 lives on the honey bee. No. 2 infests only pigeons. No. 3 is the sheep tick. No. 4 confines its activities to the tawny owl. No. 5 is one of the special parasites of the deer tribe. No. 6 attacks pigs. No. 7 is a human parasite,

the body louse, popularly called "cootie." No. 8 makes life miserable for dogs; and No. 9 penetrates even the armorlike hide of the elephant. No. 10 is the only one for which a good word might be said, for this is one of the enemies of the housefly. No. 11 is another of the creatures that prey on human beings. It is called the crab louse, because of its shape.

canals or none at all. Their organs of respiration and circulation, too, have degenerated, and so such parasites have become dull, inactive creatures at a low level of life.

Most animal parasites are invertebrates (without a backbone), though there are a few backboned parasites, such as the hagfishes or borers. These long eellike fishes attach themselves to larger fishes and eat the muscles of their victims. Another fish parasite, the lamprey, sucks the blood of its host.

Parasites in the Plant World

The best-known parasites on plants are the scale insects, which especially attack citrus fruits (see Scale Insects). Other parasites on plants lay their eggs in the plant tissues, and the young live and feed at the expense of the plant when they hatch out.

Some parasites are themselves plants. The dodder twines about other plants and sends little suckers into the host to get its food. The mistletoe is a parasite on trees (see Mistletoe). Many of the fungi, particularly the shelf or bracket fungi that grow on trees, are parasites.

The damage done by parasites, both plant and animal, is enormous. Rusts, smuts, blights, mildews, and various rots are among the most dreaded foes of the farmer. Not all parasites, however, are injurious to man's interests. That terrible pest, the tussock moth, is kept in check only by the 20 kinds of insects whose larvae live in the young moth and so destroy it. Many other injurious insects are kept down by their special parasites. Some of the worst insect pests in the United States are insects which have been brought from other lands without the parasites that keep them down in their native haunts.

The difference between "parasitism" and what is called "symbiosis" is the difference between "sponging" on a friend and going into partnership with him. The most interesting case of symbiosis is the lichen, which is a partnership between a fungus and an alga (see Lichens). The fungus supplies water and salts for the joint enterprise, and the alga manufactures the carbohydrates, on which both partners live. This odd sort of partnership also exists in other groups of plants, but it was first discovered in the lichens.

PARENT-TEACHER ASSOCIATIONS. For the most effective development of children there must be close coöperation between home and school. Parents must understand what the schools are trying to do, and teachers must understand the problems of parents. To bring about this understanding and coöperation is one of the chief aims of the many associations of parents and teachers which have been organized throughout the United States and other countries.

To promote the welfare of children these associations engage in many types of activities. They form groups to study education and child development. They improve school grounds and buildings, provide playgrounds, furnish libraries, support student loan funds, and give scholarships. Many of them also provide children with medical and dental care. In com-

munity work, they press such improvements as better housing, juvenile courts, and safety measures. They examine motion pictures, radio programs, and other forms of recreation, and work for their improvement.

These associations grew out of the great interest in child development and education that arose late in the 19th century. Progress in child psychology revealed the educational significance of a child's early years. It was realized, as never before, that much of a person's success or failure in adult life depends on what he does in childhood. Some fathers and mothers came to a new conception of their duty to help children develop right habits of health, play, and work. They also saw that traditional procedures of training children, at home as well as in school, needed to be changed in the light of the new knowledge of child Some associations of parents and development. teachers, therefore, were formed, especially in California, Illinois, and Pennsylvania.

The National Congress of Parents and Teachers

This movement spread rapidly when it was sponsored by the National Congress of Mothers. The Congress, founded in 1897 in Washington by Mrs. Theodore W. Birney and Mrs. Phoebe A. Hearst, promoted the organization of local groups and soon broadened its scope to include fathers and teachers. In 1924 its name was changed to National Congress of Parents and Teachers. In 1927 it aided in founding the International Federation of Home and School. The Congress now has more than 2,000,000 members in the United States, Alaska, and Hawaii.

Membership in the Congress is open to any parentteacher association that accepts the national by-laws and program. This program is set annually by state delegates and the board of managers. Since the purpose of the Congress is to promote child welfare, it also accepts any group that works for the care of children, such as pre-school study groups, teachers' groups, and mothers' and fathers' clubs.

PARIS. Greek legend tells us that Paris was the son of King Priam of Troy, and that he brought about the Trojan War by carrying off beautiful Helen of Sparta (see Trojan War). Before his birth, his mother Hecuba dreamed that he was a flaming torch. This dream was taken to mean that the child would grow up to destroy the city, and so he was taken out to Mount Ida and left to die. But a shepherd saved him and he grew so strong and brave that fellow-shepherds called him "champion" and he won the love of Oenone (ē-nōn'ĕ), daughter of a river god. Their happiness was brief. Called upon to award the golden apple (as told in the article Trojan War), Paris gave it to Aphrodite, who had promised him the fairest woman in the world. Deserting his wife, Paris went to Troy, where he was recognized and acknowledged as the king's son. Then he sailed to Sparta and carried off Helen. In the war that followed, Paris slew Achilles in battle, but was wounded later in the siege. He begged aid from Oenone. But she, bitter at his desertion, refused, and Paris died of his wound.

PARIS— the QUEEN of CULTURE and the SOUL of FRANCE

the balcony of the Cathedral of Notre Dame we are looking across Paris toward Montmartre, that hill there in stance. Rising in the middle of the view is the Tower of St. Jacques, formerly part of a church, but now used as a municipal observatory. Those weird creatures at the right are gargoyles—waterspouts in grotesque figures.

THE GREAT ARCH OF TRIUMPH

PARIS, FRANCE. Almost everyone who has visited Paris regards it ever after as his "second home." For Paris, the historic capital of France and one of the largest and most beautiful cities in the world,

has a rare charm that makes the traveler feel at home even in such an enchanted setting.

For hundreds of years it has been a center of the arts and learning, attracting from all over the world students of painting, sculpture, architecture, music, philosophy, literature, the drama, and the research sciences. It has always spoken the last word in fashion. Its chefs have become a symbol of the best cooking. At the

little tables of the many sidewalk cafés congenial groups may gather to chat and dine.

Its many magnificent buildings are carefully grouped along impressive boulevards. In the

second half of the nineteenth century, Napoleon III had great open spaces, or places, cleared in the city. Broad boulevards shoot out from these, like points of a star, to cut across some of the little streets that run every which way. The boulevards, long and wide, are lined with trees and set off the handsome buildings. Older streets, narrow and irregular, still scramble through blocks of all shapes and sizes that look like pieces of a picture puzzle.

The Seine River winds through the city, crossed by more than thirty bridges. On the bridges, on the

buildings, and in the parks are statues, many by famous artists. Paris is not a great manufacturing center, and so there is little smoke. The setting sun lingers over it, for the skyline is not high and jagged like those of American cities. The long twilight casts a pale, soft spell over the light gray stone buildings. With the river's flow, the faint, colorful reflections gradually slip away into the coming night.

> painting such scenes. When the day is gone, the lights of Paris begin to glow. Then all the buildings, the boulevards, and the gardens seem more beautiful than ever.

The impressionists are fond of The Arc de Triomphe de l'Étoile, the largest triumphal arch in the world, commemorates the victories of Napoleon and the soldiers of the Revolution. It stands in the center of the Place de l'Étoile. The bas-reliefs are allegorical groups representing themes of war and peace. The Arch is closed to wheeled traffic, but on gala occasions patriotic parades may pass through. The German army entering Paris in June 1940, marched through the Arch, beneath which is buried the French "Unknown Soldier," under a simple slab of stone.

For many years one of the striking sights of Paris was the great wall which completely encircled the city. It was more than 22 miles long, and had 57 gates in it. It was built between 1840 and 1845. But at the close of the World War of 1914-1918 it was decided to demolish the wall, as it had outlived its usefulness, and to replace it by a continuous, circular boulevard.

THE PLACE DE LA CONCORDE FROM ACROSS THE SEINE



This is the finest of all the open spaces of Paris, the Place de la Concorde. That ohelisk in the center of the square is from the great temple at Luxor, Upper Egypt, and on either side are two fountains with the decorative sculptural figures so characteristic of French art. The bridge, which is one of the numerous handsome structures across the Seine, is called the Pont de la Concorde. Only pleasure steamers, such as the one we see, and low freight harges, can pass under these bridges. The classic building at the end of the street leading from the bridge—the Rue Royale—is the Madeleine, a church which was built by Napoleon I as a "temple of glory." On the left of the square, we enter the famous Champs Elysées. On the right is the entrance to the historic Gardens of the Tuileries.

On the right or north side of the river are the business districts and the residence districts where the rich people live. The big park, the Bois de Boulogne, where all fashionable people go driving on Sundays, is on this side, and so is the Longchamps race track.

On the left bank is the Latin Quarter. This is so called because it grew up around the University of Paris, and long ago, when Latin was the language of all learned people and was used in the universities, the students used to go about the streets singing Latin songs. Since the Middle Ages, the Latin Quarter has been the home of artists and students and revolutionaries. It's a queer, poor, unconventional place, like no other place in the world.

On an island in the middle of the river, where the original city of Paris once stood, is the cathedral of Notre Dame, one of the greatest of Gothic cathedrals, tall and gray and very, very beautiful (for illustration see Architecture).

One of the most important places in Paris is the Place de l'Opéra, where the sumptuous Grand Opera House stands. They say that if you sit at a little table on the sidewalk there, and watch the people pass, in course of time you will see everybody in

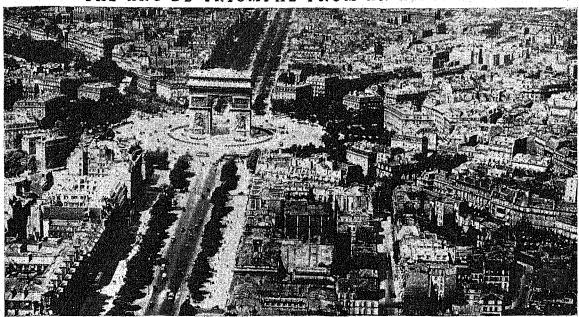
the world. It is very nearly a true saying, for almost everyone who goes abroad is sure first or last to reach the Place de l'Opéra. The very fashionable Rue de la Paix, with its world-famous luxury shops, leads into the Place Vendôme. Here is the Vendôme column, with a statue of Napoleon I at the top. The bronzed pillar has spiral scenes in low relief. The metal for this column came from melting down Russian and Austrian cannon captured in the course of Napoleon's campaign in 1805. On the Place de la Bastille once stood the grim prison, symbol of repression, which was stormed and completely destroyed by the Revolutionists on July 14, 1789. The magnificent Place de la Concorde, where the Egyptian obelisk now stands, saw the guilloting at work during the French Revolution. It is here that Marie Antoinette and so many others were beheaded during the Reign of Terror. The wide Rue Royale leads on to the Place de la Madeleine. The handsome church which gives its name to this square is noted for its splendid organ and sacred music.

At the end of the beautiful boulevard called the Champs Elysées, or Elysian Fields, stands the great Arch of Triumph, begun by Napoleon "in honor of the

victories of France."

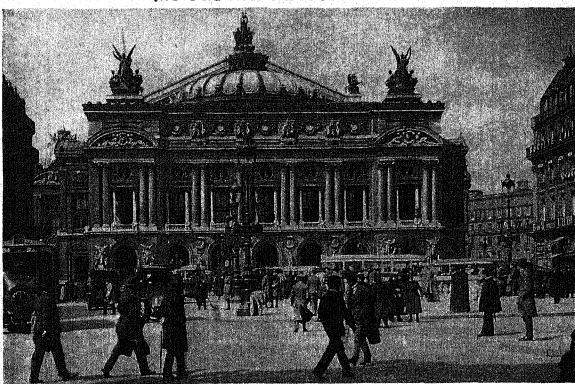
RELEPTING TO LE

THE ARC DE TRIOMPHE FROM AN AIRPLANE



We are crossing Paris in an airplane. Before us is the Place de l'Étoile with the Arc de Triomphe in the center. From here radiate some of Paris' most famous avenues and boulevards. The street nearest to us, leading to the arch, is the Champs Elysées, which beyond the arch is known as the Avenue de la Grande Armée. Crossing the space diagonally, from the upper left hand corner, is the Avenue Foch, formerly the Avenue du Bois de Boulogne.

THE FRENCH NATIONAL OPERA



The Paris Opéra, before which we are now standing, is perhaps the best known theater in the world, and one of the most beautiful. The front is decorated on the ground story with allegorical groups representing Music, Lyrical Poetry, Lyrical Drama, and Dancing, High against the sky, on the top of the pediment, Apollo, the God of Music, with his uplifted lyre, is seen against the sky. The Opéra is maintained by a government subsidy.

Paris has also many palaces—the Louvre, the Palace of the Luxembourg, the Palais Royale, These used to belong the Palais Bourbon, etc. to the kings. Since France has been a republic, they have been, for the most part, public buildings, belonging to the nation or the city. The Louvre is one of the greatest art museums in the world. It is filled with renowned paintings and sculptures, and with collections of Greek, Roman, and Egyptian art. The works of painting and sculpture by living artists are

Middle Ages to hold the crown of thorns and a piece of the "true cross" brought by him from the Holy Land; St. Germain des Près, where Saint Geneviève. the patron saint of Paris, is buried; and the modern churches of the Madeleine and the Panthéon. In the Panthéon many of the eminent men of France are buried. On the hill of Montmartre stands the modern church of the Sacré Coeur, or Sacred Heart. It is built in the form of an oriental mosque, and it can be seen from almost any part of the city.

IN THE LUXEMBOURG GARDENS



We are here looking down one of the beautiful walks in the Jardin du Luxembourg. At the far end we see the building occupied by the French senate.

housed in the Luxembourg Palace. For an artist to have his work bought by this museum is the greatest honor that can befall him.

The other palaces are mostly government buildings, where the work of ruling the country is carried on. For, as Paris is the capital of France, the president of the republic, the senate, the chamber of deputies, the different ministries, and the embassies of the foreign nations are all located here.

Paris has also many lovely gardens, two of them, the Tuileries and the gardens of the Luxembourg. being as beautiful as any in the world.

The most famous streets of Paris are the Champs Elysées, the Rue de Rivoli, which has arcades along it for miles, the Rue Royale, the Grands Boulevards, the Boulevard St. Michel in the Latin Quarter (commonly called, in student slang, the "Boul Mich"), the Rue du Faubourg St. Honoré, the Avenue Foch, the Boulevard St. Germain, and the Boulevard Montparnasse. The most famous of the many churches. aside from the cathedral of Nôtre Dame, are the beautiful Sainte Chapelle, built by Saint Louis in the

Other famous spots are the Sorbonne, the largest of the colleges of the University of Paris; the cemetery of Père la Chaise, where many famous people are buried; the Hotel des Invalides, the military museum where stands the tomb of Napoleon (Grant's tomb in New York is patterned after this); the Palais de Justice; the Conciergerie, the old prison that has seen so many tragedies; and the Champs de Mars. In the Champs de Mars is the famous Eiffel Tower, a huge iron structure, nearly 1,000 feet high, completed for the World's Exposition of 1889. Besides being used for making scientific observations and as a wireless station, it is one of the best places to get a view of the city as a whole.

The business of the city is mostly in what are called luxuries—beautiful things that are not really necessary, like jewelry, perfumery, gloves, very expensive dresses, bronzes, and other things. The Bank of France, the center of French finance, is here also. During the World War a number of large factories sprang up on the outskirts of the town, in what they call the "faubourgs" or suburbs, where the poor people



live. In these factories ammunition shells and other munitions were made. They have since been put to other uses, but Paris is still far from being a manufacturing city, in the sense that Birmingham and Manchester and Pittsburgh are manufacturing cities, with their chimneys and clouds of smoke.

The underground railway, the principal means of transportation of Paris, is named the Métropolitain and is called the "Métro" for short. In 1910 the Seine flooded and filled its "tubes" with water.

Paris is a very old city and is full of historical memories. In almost every street and on every place some great man has lived, or some great event has happened. So there is never any end to learning about Paris.

The name "Paris" came from a tribe of early Gauls, called by the Romans Parisii, whose mud huts were on the island in the Seine where stands the cathedral. In the time of Christ, Paris was a Roman city named Lutetia. In the 4th century it was christened Paris, and in the 10th the counts who ruled it gained the crown of France. From the 12th century the capital was Paris. The kings built many of the beautiful palaces and monuments that made the city what it is, those who did the most for the city being Philip Augustus, Louis XI, Henry IV, and Louis XIV.

Under Napoleon Bonaparte, who came to power after the French Revolution (1789-1795), many new quays, bridges, streets, squares, markets, and public gardens were created. But it was reserved for his nephew Napoleon III (1851-1870) to make Paris the most splendid and beautiful of modern cities. Up to his time Paris still consisted of a labyrinth of crooked and unsanitary little streets. Now great parts of the city were rebuilt, and broad boulevards were constructed to traverse it from north to south and east to west and around the outskirts of the old city. It was the most amazing example of the making over of a city that the world up to that time had seen. Unfortunately financial difficulties delayed the completion of the work; and in the bloody days of the Communist uprising of 1871, following the downfall of Napoleon III and the march of the victorious Germans through the city, much wanton destruction took place. The Vendôme Column erected by Napoleon I was pulled down, and many public and private buildings, including the famous Tuileries palace, were burned by the Red Republicans.

Bombarded during the World War

During the World War of 1914–1918 the Germans attacked Paris, bombarding it frequently by airplane and by long-range cannon. In the war that broke out in September 1939 Paris was again one of the objectives of the Germans, and in June 1940 the German army reached Paris and took over the city. The population had fled, and Paris had been declared an "open city" in order to prevent its destruction.

The visitor to Paris should not leave without going beyond the low-lying hills which encircle it on all sides and visiting some of the interesting suburbs—St.

Cloud, famous for its beautiful shady park and the view it commands of Paris; St. Denis, whose venerable abbey is the burial place of many of the kings of France, especially the Bourbon kings, including the unfortunate Louis XVI and Marie Antoinette; Vincennes, with its ancient castle which was long a state prison; Neuilly, familiar to Americans as the location of one of the best known of American army hospitals during the World War; and Sèvres, where the celebrated Sèvres porcelain is manufactured. Population of Paris, about 2,830,000.

PARKER, SIR GILBERT (1862-1932). In the early days before he became one of the most popular novelists in the English-speaking countries, Gilbert Parker went from Canada to London to publish a series of stories dealing with Canadian life. But after consulting with a friend, and rereading his manuscript carefully, he felt dissatisfied with his work and burned the stories one by one. The next day he happened to pass a second-hand shop, and saw in the window the uniform of an officer of the time of Wellington and beside it the leather coat and fur cap of a trapper of the Hudson's Bay Company. These objects caught his imagination and brought back memories of his own boyhood, passed on the edge of that wild and romantic region of northern Canada. "At that window," he said, "I commenced to build again upon the ashes of last night's fire. Pretty Pierre, the French halfbreed, or rather the original of him as I knew him when a child, looked out of the window at me." Parker went home and began to write the first of the series of stories entitled 'Pierre and His People'.

Gilbert Parker was born at Camden East, Addington, Ontario, and was educated at Trinity College, Toronto. In 1886 he went to Australia and became associate editor of a newspaper in Sydney. After traveling extensively among the South Sea Islands, in Europe, Asia, and Egypt, he settled in London in 1897.

His best novels—among which are 'The Right of Way', 'The Seats of the Mighty', 'The Trail of the Sword'—deal with pioneer life in his native land. But he did not confine his attention to any one country. Most of the places he lived in or visited served him as backgrounds for one or more of his novels, or furnished material for his books of travels. The scene of 'The Weavers', for instance, is laid in Egypt, and that of 'Cumner's Son' in the South Sea Islands. He was a good story teller, handling atmosphere in a very skilful manner and creating vivid and interesting characters though he did not penetrate deeply into human nature or the problems of life. Usually he gave a romantic treatment of love and war against a historical background.

He did not devote all of his attention by any means to literature, but took a very active interest in politics. His residence in Canada and Australia made him a strong Imperialist, a believer in the close union of the dominions and colonies of the British Empire. He was elected to the British Parliament in 1900 as a Conservative, and served for many years. In addition he

was a member of a number of important committees. During the World War of 1914-18 he had charge of the British publicity work in America. In this capacity he wrote a large number of magazine articles, some of which will probably prove of permanent literary value. He was knighted in 1902, and in 1915 was made a baronet for his war work.

Sir Gilbert Parker's chief works are: 'Pierre and His People' (1892); 'Mrs. Falchion' (1893); 'The Trail of the Sword' (1894); 'When Valmond Came to Pontiac' (1895); 'An Adventurer of the North' (1895); 'The Seats of the Mighty' (1896); 'The Pomp of the Lavillettes' (1897); 'The Battle of the Strong' (1898): 'The Lane that Had No Turning' (1900); 'The Right of Way' (1901); 'Donovan Rasha' (1902); 'History of Old Quebec' (1903); 'A Ladder of Swords' (1904); 'The Weavers' (1907); 'Northern Lights' (1909); 'Cumner's Son' (1910); 'The Land, the People, and the State' (1910); 'The Judgment House' (1913); 'You North House' (1913); 'You Never Know Your Luck' (1915); 'The World in the Crucible' (1915); 'The Money Master' (1915); 'The World for Sale' (1916); 'Wild Youth, and Another' (1919).

PARKMAN, Francis (1823-1893). While he was still a sophomore at Harvard University, Francis Parkman, the most brilliant of American historians,

resolved to write the story of the struggle between the French and English for the possession of the North American continent—or as he says -"the history of the American forest." He made his next few years a preparation for the hardships which he knew that he must undergo in collecting material among the Indians of the Never robust, his Northwest. health broke down one summer under the Spartan exercises which he practiced, and he went to Europe for a year of rest and travel. Notwithstanding this, he was graduated with his class in 1844, taking high rank.

Already his vacations had been spent in exploring the woods

within easy reach. In 1846 hestarted out with a friend for a trip over the then new Oregon trail. From St. Louis they traveled up the Missouri River to the site of Kansas City. There amid a rough crowd of all sorts and ranks of people they bought their horses, gathered their outfit, and hired their guides. After enduring many hardships they finally reached the valley of the Platte River.

They pressed on across the lonely country which stretched "for league after league as level as a lake," with "skulls and whitening bones of buffaloes scattered everywhere." They visited many Indians in their camps and were entertained by them according to their customs. In return, the two white men gave a feast at which the Indian delicacy, dog-meat, furnished the chief dish, and the very sweet tea was colored with soot, to make it seem stronger. Parkman had ample opportunity to study the Indians as

they really were, and not as they had been sentimentalized by Cooper and other writers.

Parkman's trip was of inestimable value to him in carrying out his life's plan, but it undermined his delicate health. A diet exclusively of meat, exposure to storms, fatigue, and a lack of any care during a severe illness, made him an invalid for the rest of his life. The chief trouble was with his eyes. He could not bear light and was forced to spend most of his time in a darkened room. There were periods, too, when any thinking or writing made him feel as though there were an iron band around his head.

In spite of these difficulties, however, he published 'The Oregon Trail' on his return, and several years later appeared 'The Conspiracy of Pontiac'. Parts of these books he wrote with his own hand, guiding his pen in a darkened room by means of wires strung at intervals across a writing board. His wife and her sister as well as members of his own family helped him by reading aloud, gathering material, and taking his dictation. Sometimes he could write only six lines a day, and it took him two and one-half years to com-

plete one of his books.

In 1858 Parkman's health was so bad that he had to give up work altogether. He went to Paris to consult the best physician of that time, but found no relief. No matter how much he suffered he always turned a cheerful face to the world. Few people knew what

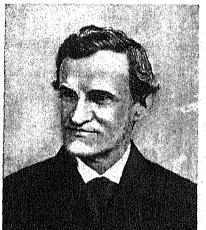
history of France in the New World. His books were recognized as of the highest order, and Park-

it cost him to give up writing and turn to raising roses. After seven years he had recovered his health sufficiently to continue his work, and in 1865 he began the publication of his long series of books dealing with the

man had the satisfaction of knowing that his work was appreciated at its full value. His place as an historian is high, for he had a combination of unusual gifts. He had the tenacity and patience of a great scholar in collecting material from all possible sources. Not only did he gain a firm basis of fact, but he knew how to treat those facts with great literary skill. He made the lonely trapper, trader, soldier, priest, and voyageur live again his life of adventure amid the wilds of a new world, whose forests, streams, prairies, and mountains are so vividly described that they too like the kings. statesmen, and explorers became part of the historic drama. 'The Oregon Trail' should be read by everybody who is interested in the development and early

Among the best of Parkman's books are 'The Oregon Trail' (1849); 'The Conspiracy of Pontiac' (1851); 'Montcalm and Wolfe' (1884); 'A Half-Century of Conflict' (1892).

history of the great West.



FRANCIS PARKMAN Brilliant American Historian

The MOTHER of PARLIAMENTS By the Thames' Side

Though the Houses of Parliament are a modern structure (1840-50), they enshrine Westminster Hall, which was built more than eight centuries ago and survived the fire of 1834 that destroyed nearly all of ancient Westminster Palace. The House of Commons and other parts of the vast structure were destructively bombed by the Germans in the second World War.

PARLIAMENT. The Parliament which has been making England's laws for more than 650 years is called the "Mother of Parliaments" because the supreme legislative bodies of so many other nations have been patterned after it. It might well be argued that England's greatest contribution to the world has been the creation of this type of legislative assembly. Many ceremonies of the ancient Parliament that meets on the banks of the Thames in London date back to the time of Henry VII and Henry VIII -the dawn of modern history. Its division into two houses-House of Lords and House of Commons -took place in the middle of the 14th century, 150 years before Columbus discovered America. And Westminster Hall, where some of the earliest parliaments sat and which is now the vestibule to the Parliament Building, is a relic of the palace of King William II, begun in 1097.

There never has been a time since England has been united into a single kingdom when some sort of assembly did not aid the king in governing. In Anglo-Saxon days this body was called the "Witenagemot," or assembly of "wise men," and it was made up of bishops and abbots, king's thegas (his personal followers), and the chief officers of the kingdom. This assembly made laws, imposed taxes, acted as a supreme court of justice, and elected the sovereign.

After the Norman conquest the kings called together their "Great Council," composed of feudal lords who held land directly from the king. These persons all sat in the assembly "in their own right," by virtue of their lands or offices. It was not until the 13th century that *elected* representatives were added

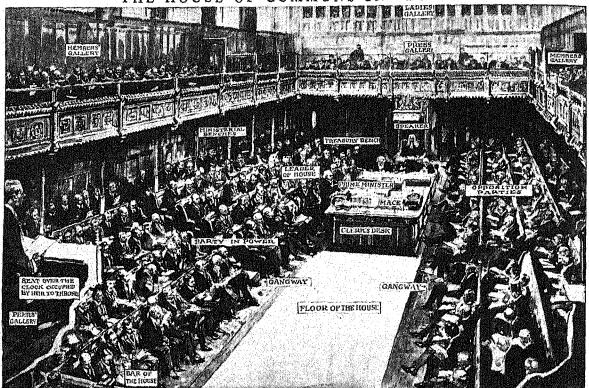
to the assembly, and it is this representative character which chiefly makes the difference between the feudal Great Council and the modern Parliament.

In 1265, for the first time, representatives of the towns were called, with the "knights of the shire," who had been summoned occasionally before, to meet with the Great Council. This Parliament was called by Simon de Montfort (see Montfort, Simon de) in the time of the Barons' Wars against the king. But in 1295 Edward I himself called an assembly which established it as a rule that in a Parliament there ought to be representatives of the counties and the towns along with the lords. This was called the "Model Parliament," because it became a model for succeeding bodies in England.

At first the representatives of the counties and towns sat in the same body with the barons and great churchmen; but by the year 1340 the Parliament had separated into two "houses." The Upper House became the hereditary House of Lords, and included the great barons (who now bear the titles of duke, marquis, viscount, and baron) and also the archbishops and bishops, and the abbots or heads of monasteries. Since the religious Reformation the abbots have disappeared from Parliament, and the number of bishops who sit in that body has been limited.

The Lower House, which consisted of the county and borough members, became the elective House of Commons. At first, representation in Parliament was regarded by the towns and counties as a burden. But in course of time the House of Commons became the most important part of Parliament. This was because it was called upon especially to vote the taxes which the

THE HOUSE OF COMMONS IN SESSION



The Prime Minister and his associates in the government sit on the front benches at the Speaker's right. Members who wish to address the House rise in their places, and wait for recognition from the Speaker. Members who rise to speak must remove their hats, but otherwise they may keep their heads covered if they wish. Because the Ministers are busy most of the day with the affairs of their departments, the important sessions of the House are usually at night, and often continue far into the morning.

king needed for carrying on the government. In time it became an established rule that all bills dealing with money must start in the House of Commons, then the right of the Lords to amend money bills was lost, and in 1911 a law was passed that such a bill could not even be rejected by the House of Lords. The House of Commons thus has supreme authority in raising and appropriating money.

For more than a hundred years after the time of Charles II (1660-1685) there was almost no change in the places represented in the House of Commons, and so grave abuses arose. Many of the members represented what were known as "rotten boroughs," that is, towns which had so declined in population that they were no longer important. Some places which sent representatives in the early 19th century were mere mounds and ditches, without any inhabitants, or were towns which years before had been swallowed up by the sea. Sometimes these places were called "pocket boroughs," because the lord of the land practically named the members himself-carried them about "in his pocket," so to speak. Often such seats in Parliament were almost openly bought and sold. On the other hand many of the great manufacturing towns, which had sprung up as a result of the Industrial Revolution, had no separate representatives in Parliament apart from the two representatives given to every county or shire. There were also great complaints arising out of the restrictions and inequalities in the right to vote for members of Parliament.

The first general reform of these abuses was in the great Reform Bill of 1832. By its provisions many of the small boroughs lost all or part of their representatives in Parliament, while the great manufacturing towns gained representation. At the same time the "franchise," or right to vote, was made more liberal, so that small landholders in the counties secured the vote, and the franchise in the towns was made uniform. Later laws, passed in 1867 and in 1884-85, further reformed the House of Commons by giving more people the right to vote and giving representatives to additional towns and districts. Then in 1918 a law was passed giving women over 30 years of age the franchise, and ten years later the age limit was lowered to 21.

The hereditary House of Lords has also been reformed, but the reformation of it has meant the loss of its power to block legislation which the people demanded. Since 1911 any money bill passed by the House of Commons becomes a law without the assent of the House of Lords; and any other bill that is passed by three successive sessions of the House of Commons may become a law, even if the House of Lords refuses to pass it.

In the House of Lords today there are about 700 members, including 28 Irish peers elected by the nobility of Ireland for life, and 16 Scottish peers elected by the nobles of Scotland for the duration of Parliament. In this House still sit the archbishops of Canterbury and York, 24 bishops, and certain "law lords" who are appointed because of their legal ability and take part in the work of the House of Lords as a supreme court.

The House of Commons consists of members representing the counties, the towns, and the universities. There are 615 members in this House, elected for the duration of Parliament, which cannot now be longer than five years; it may, of course, be shorter if the assembly is dissolved by the advice of the prime minister. The chief leaders of the party which has the majority in the House of Commons, together with the leaders of that party in the House of Lords, make up the Cabinet, which guides the business of Parliament and at the same time forms the responsible executive of the country (see Cabinet).

The King's Veto Power Only Nominal

The acts of Parliament must be approved by the Crown, which in theory has the right of veto; but as the royal assent has not been withheld from an act of legislation since the time of Queen Anne—more than 200 years ago—we may say that the right of royal veto has in practise disappeared in Great Britain.

In the hundreds of years that Parliaments have been meeting, some sessions have gained special fame and a special name. There was the Model Parliament of 1295 mentioned before. The Long Parliament summoned by Charles I in 1640 lasted legally until 1660, though during the time of the Protectorate it was not in session. After the army had driven out some of the members of this Parliament in 1648 the remnant was scornfully called the "Rump." In 1653 Oliver Cromwell called together an assembly which his enemies called "Barebone's Parliament" because one of its members was named Praise-God Barebone. The Cavalier or Drunken Parliament of Charles II, also called the Long Parliament of the Restoration, lasted from 1661 to 1679.

Changes in Scottish and Irish Parliaments

Scotland ceased to have a Parliament of its own and began sending members to the Parliament at Westminster (London) when Scotland was joined with England in 1707, during the reign of Queen Anne, to form the kingdom of Great Britain.

Ireland had its separate Parliament until 1801, when it too was merged in the Parliament of Great Britain. In 1921, after 50 years of agitation for home rule, a separate Parliament was established for Northern Ireland, and the following year the Irish Free State obtained dominion status with an independent Parliament (see Ireland).

"The MEETING Will Please COME to ORDER"

Parliamentary Law Regulates Procedure in Meetings of Organizations—Drawing Up the Constitution—President's Duties—Who Shall Speak First—
"Class Distinctions" in Motions

PARLIAMENTARY LAW. Meetings of societies, clubs, or even legislatures would be chaos if they were not conducted by rules. These rules are known as parliamentary law. The name comes from the British Parliament, which originated the fundamental rules that still are used, with modifications.

When a group of people wish to organize a club, they first elect a temporary chairman and a secretary. Then a special committee is appointed by the chairman or by the assembly to draft a constitution, the framework of the organization, and by-laws, containing detailed rules for conducting business. These rules may be expanded when necessary. Some clubs work out the by-laws at meetings of the entire membership instead of in committee meeting.

The Constitution and Its Acceptance

The articles of the constitution usually set forth the club's name and object; qualifications for membership; method and time of electing officers; duties of officers; when meetings are to be held; amount of dues; how many constitute a quorum; how the constitution can be amended; and how many votes are required. By-laws may list duties of members, standing committees, and routine of business, which may be in the following order: roll call, reading of minutes of previous meeting, reports of standing and special committees, unfinished and new business, regular work of the club, and finally, motion to adjourn. As the secretary reads, section by section, the preliminary draft of the constitution and by-laws, or writes it on a blackboard, the club votes to accept or to amend it.

Duties of Officers and Members

Election of permanent officers is in order after the constitution and by-laws have been accepted. Officers are usually president, vice-president, secretary, treasurer, and perhaps sergeant-at-arms. Often the same person acts as secretary and treasurer. Many organizations have an executive committee made up of the officers and two or three other members, to decide important problems. Candidates for office are nominated from the floor, or by a committee. After all the candidates have been named, someone moves that the nomination be closed. Members then vote for the nominees, or perhaps for some unnamed member, usually by secret ballot. The candidate who gets the majority of votes is elected.

Standing committees, or permanent committees whose selection is usually explained in the constitution, and special, or temporary committees, appointed

by the president, club or committee chairman, do much of the specialized work of an organization.

Presiding at Meetings

If you are elected president, you open each meeting by saying, "The club will please come to order," or something to that effect. Then you proceed with the routine of business. A member who wishes to present plans or suggestions must rise, address the chair, and be recognized by you before he can make a proposalcalled a motion in parliamentary law. You recognize him by facing him and saying, "The gentleman (or the lady) has the floor," or by merely calling his name. To whom shall you "give the floor" if two or three jump to their feet at once? You allow the maker

of a motion to talk first on his motion, you recognize a person who has not yet voiced his views, or you favor a member who rarely has the floor. Always refer to yourself in the third person. For instance, instead of saying, "I appoint John O'Brien chairman of the committee," you should say, "The chair appoints John, etc." The president may vote always when the vote is by ballot or by yeas or nays, or otherwise when his vote will decide a question. He cannot debate a question unless he asks another officer or member to preside in his place while he expresses his opinions.

The president stands when stating questions, when presenting a question for vote, when reading vote returns, and when talking on a point of order. When a member has proposed a motion, the president states the motion and asks for a second. After the motion has been seconded, he asks, "Are there any remarks?"

If there are none, he asks for the vote in some such form as this: "It has been moved and seconded that the club have a picnic at Hallowell's cottage on June 1. All those in favor signify by saying 'Aye'; those opposed say 'No'."

Then, after the vote he announces: "The motion is carried (or is lost)."

Keeping the Minutes

A secretary keeps the minutes, or records, of each meeting, and calls roll. In the minutes he records the kind of meeting (regular or special), date and place, presiding and recording officers, reading of minutes, business discussed, and time of adjournment. The members approve the minutes, amending them if necessary. The secretary reads all papers and calls the meetings when presiding officers are absent; he always stands when reading to the members. If the president is absent, the vice-president presides. The treasurer takes charge of the club funds. The sergeantat-arms keeps order.

The members are the true rulers of a club. Without their consent, no measure can pass. A member who wishes to have the floor always stands and addresses the presiding officer as Mr. or Madam Chairman or Mr. or Madam President. Wishing to make a motion, he says, for example, "I move that the club have a picnic at Hallowell's cottage on June 1." Another member may say, "I second the motion," without rising. Voting is possible only if a quorum is present. A quorum is the minimum number of members required by the constitution to conduct business,

in club meetings, or in specified

committees.

"Class Distinctions" in Motions

Motions or proposals submitted are classified to avoid confusion in case several questions come before the house at once. Privileged motions claim first attention, incidental motions come second, subsidiary motions third, principal motions last. Privileged motions deal with the rights of members. A motion fixing the time or place at which to reassemble takes precedence over every other possible question. Lesser privileged motions, in order of precedence, are those to adjourn; to take a recess; to rise to a question of privilege (to secure the comfort of the club if the room gets too cold, for instance); or to call for the order of the day, that is, to bring up scheduled business when time is growing short. All privileged motions except that of questions of privilege are undebatable, and must be put to vote by the president

before other questions that may be under discussion

at the time. Making "Points of Order" Incidental motions, rising out of other motions, relate, in the order of their precedence, to points of order (a member is privileged to call the attention of the president to errors in parliamentary procedure, and the president decides whether the point is, or is not, well taken); to an appeal (a member may appeal to the assembly if he believes the president wrong in his decision on a point of order); to objections (a member may object to consideration of a trifling principal motion); to reading of papers; to dividing or withdrawing motions; and to suspending the rules (only parliamentary rules and special club rules may be suspended, never constitution or by-laws). An appeal is the only debatable incidental motion.

PARLIAMENTARY MOTIONS CLASSIFIED Privileged Motions

- 1. Time and place to reassemble.
- 2. To adjourn. 3. To take recess.
- 4. Questions of privilege.
- 5. Call for the order of the day.

Incidental Motions

- 1. Points of order.
- 2. Appeal. 3. The objection (requires two-thirds vote).
- To read papers.
- 5. To divide a motion.
- 6. To withdraw a motion.
- 7. To suspend the rules (requires twothirds vote).

Subsidiary Motions

- 1. To lay on the table.
- 2. To call for the previous question (requires two-thirds vote).
- To postpone to a definite time.
- To refer to a committee.
- To postpone indefinitely. These three
- To amend the amendment. motions are

) ofequal rank. To amend. Main or Principal Motions All motions bringing up new business

(Debatable motions are italicized, All others are undebatable.)

This table shows the various motions which may properly be made, classified as explained in the text, in order of precedence.

Subsidiary motions include, in order of precedence, to lay on the table (to postpone a discussion until later) or to take from the table, to call for the previous question (in order to cut short debate and bring a question to vote), to postpone to a definite time, and to refer to a committee. Three subsidiary motions on equal footing with each other relate to postponing a subject indefinitely, to amending a motion, and to amending an amendment. All subsidiary questions except to lay on the table and to call for the previous question are debatable.

Motions Out of Order

Principal motions include chiefly main motions which bring up new business, and all are debatable. A principal motion is out of order if made when any other question is before the club. A member might make the principal motion, "I move the club buy a picture of George Washington for South Hall." While the club discusses this matter, another member might rise and suggest, "I move the club send flowers to Miss Seymour." The second motion would be ruled "out of order" by the president because a previous principal motion was still before the club. However, while the motion to buy the Washington picture is debated, a member might rise and say, "I move the matter be referred to a committee." Since the motion to refer to a committee is a subsidiary motion, it claims precedence over any principal motion, and the club must drop its picture debate for the moment and accept or reject the committee motion. Suppose, however, that before the club has had time to vote on the committee motion, another member moves that the assembly take a recess, the club must immediately jump from the committee question to the recess question, because the motion to take a recess is a privileged motion and claims attention, as a rule, over motions of any other class, and must be put to vote immediately.

Moving and Seconding

Motions must be seconded, as a rule, before any vote is taken. A motion that has failed to pass may be "reconsidered" later. Only motions changing a regulation or custom require a two-thirds majority; all others call for a mere majority. A motion that has been presented to the club by the president becomes a question. After it has passed, a question becomes an order if it is a command; otherwise it is known as a resolution.

Voting is carried on by ballot, by a rising vote, by a chorus of "ayes" and "noes," or "yeas" and "nays," or by a raising of hands.

Authoritative reference works on parliamentary law are 'Parliamentary Law' by F. M. Gregg and 'Rules of Order' by Brig.-Gen. Henry M. Robert.

PARNELL', CHARLES STEWART (1846–1891). This greatest of modern Irish leaders was largely of English and American ancestry, was a landlord and a Protestant, and had nothing of the traditional Celtic Irish temperament. But hatred of England and the English early became a ruling motive of his life.

Asked in 1874, "Why don't you go into Parliament?" Parnell answered at once, "I will; whom ought I to see?" The Home Rulers, who were then just beginning to make themselves a factor in politics, offered him a nomination. He was in many ways unsuited to political life. Ignorant of Irish history and knowing less about Irish politics, he found it also difficult to express what he did know. It is not surprising that he was beaten in his first effort. "Well, boys," he said, "I am beaten, but they are not done with me yet." A year later he carried the Meath election and entered the House of Commons.

The organized Home Rule movement was then only five years old. Six years earlier the English church in Ireland had been deprived of its privileged position as an established church in a country chiefly Roman Catholic (see Ireland). Only five years before Gladstone had first taken up the vexed question of tenants' rights in the land they rented, and passed the Land Act of 1870, which improved the position of tenants by giving them compensation for improvements. There was still much to do. Irish land rents were high, and were paid usually to landlords who lived in England and who had little interest in their Further, the Irish people wished selfgovernment. In the glorious days of 1782 to 1798, an Irish Parliament had played a historic rôle. They could not forget that parliament, nor could they forget old bitternesses against England. Many "Fenians"—as they called themselves—demanded nothing less than independence, and engaged in numerous plots against the British government.

The former leader of the Home Rule party hoped by conciliatory methods to win English support for the cause. Parnell, as a member of Parliament at Westminster, played a very difficult rôle. He showed no regard for English public opinion, he spoke with the most biting scorn, and began a policy of obstruction and delay in Parliament. He did it all quietly and showed little concern at the bitter antagonism he roused. This policy made him a hero in Ireland and served to unite behind him both Home Rulers and Fenians. In 1877 he became the Irish leader.

The "Boycott" Policy

In 1880 the Liberal Party introduced a land bill to relieve the tenants who, because of famine, could not pay their rents. That bill failed and the landlords again set out to drive the tenantry from their holdings. Under Parnell's inspiration a policy of "boycott" was adopted all over Ireland (see Boycott). Landlords who had evicted their starving tenantry found they could not re-rent their lands. But the method did not cure the real distress of the peasantry. A Land League was formed which soon had 200 branches in Ireland. Then the government adopted "coercion" and Parnell answered by "obstruction." The government introduced another land bill under which fair and stable rents were to be fixed by tribunals and tenants were given the right to sell the good-will of their holdings. Parnell was not grateful when this became law (1881). Neither he nor his followers voted for the bill. It did not go far enough to suit him, and he did not discourage the peasantry when they refused to make use of the bill.

Parnell was arrested and put in Kilmainham jail. Asked by his supporters who would take his place, he replied, "Captain Moonlight." He proved right, for once more disorders moved the English government to concessions. Gladstone made an informal bargain with Parnell (Kilmainham Treaty) by which disorders in Ireland were to stop and Gladstone would introduce a Home Rule Bill. Parnell left prison, disorders almost ceased, and all looked well for Home Rule. Unhappily for Ireland, the chief secretary of Ireland and the under-secretary were both murdered in Phoenix Park (Dublin). The murder shocked Britain and spoiled Parnell's victory. Once more the government resorted to coercion. Gladstone indeed brought in a Home Rule Bill in 1886, but opinion was running against the Irish and Gladstone failed to pass his measure. The Liberal Party upon which Parnell had relied split apart and went out of office (see Gladstone). Fire and murder followed in Ireland, and the government resorted again to coercion.

Parnell is Falsely Accused

In 1887 the London Times brought out a series of articles accusing Parnell of aiding and encouraging the policy of crime in Ireland. They even printed a facsimile letter in which Parnell approved the Phoenix Park murders. Parnell denied that the letter was genuine, and the matter was tried before a judicial commission. It turned out that a rascal named Pigott had forged the letter and sold it to the Times.

The outcome increased Parnell's prestige. He was lionized by London society, was petted by the Liberal Party, and stood close to Gladstone. It seemed probable that as soon as the Liberals were returned to power Parnell would accomplish his life aim.

Before this came to pass Captain O'Shea, one of Parnell's party lieutenants, sued his wife for divorce, naming Parnell. The divorce was granted and Parnell soon married Mrs. O'Shea. The Irish party upheld Parnell, but there was a storm in England. Gladstone was made to see that if he stood by Parnell he could not hold the English Nonconformist vote, and hence refused to deal with Parnell as the Irish leader. The Irish party then threw over Parnell. Parnell refused to resign and fought to the end. His death from pneumonia, which occurred three months after his marriage, left the Irish party under divided leadership, and postponed for many years any effective renewal of the fight for Ireland's cause.

PARROTS, MACAWS, AND COCKATOOS. Few species of birds are more brilliantly feathered, more screamingly noisy, or cleverer in the use of beak and claw than members of this widespread group. Including the macaws and cockatoos with the parrots, to whom they are closely related, there are about 560 species of these gorgeous birds. They inhabit South America, Africa, the East Indies, Australia, and New Zealand.

All are characterized by the large arched upper beak, and by the position of the toes, two of which point forward and two backward. Most parrots have harsh screaming voices. Some have the power of imitation and can be taught to speak a few words. The gray parrot of Africa is most easily trained to talk. Parrots are good climbers, strong fliers, but clumsy walkers. They usually nest in hollow trees, and are said to mate for life. They endure cage life well. They are long-lived, some living 70 years.

One hundred and ninety species of parrots inhabit the New World. Only one is found in the United States. This is the thick-billed parrot which occasionally enters Arizona from Mexico. Until recent times the Carolina and Louisiana paroquets occurred in great numbers in the eastern United States from Florida to the Great Lakes, but these beautifully plumaged birds have been completely exterminated: by milliners for their plumage, by sportsmen, and by farmers, because the paroquets ate orchard fruit.

The forests of South America, especially, abound with these bright colored birds. The blunt-tailed parrot, a common parrot of the zoölogical gardens, is a native of the Orinoco territory. It is a bright green color with blue on the head and markings of red or vellow on throat and wings.

The macaws are a long-tailed group of larger parrots, numbering about 15 species, found most abundantly in Paraguay and Brazil. The macaws are the most gorgeously colored members of the parrot group, the red and blue being one of the handsomest.

The Screaming Cockatoos

The cockatoos, found in the Australian regions, are similar to the parrots in habit. They thrive well in captivity and may be taught a few words, but are more apt to use their voices in screaming. The plumage of the cockatoo is generally white tinged with red, orange, and other colors. Most species have a large crest of feathers that can be raised to a height of as much as five inches, but which lies smooth when the bird is quiet. These birds fly about in flocks of 100 to 1,000 and are very destructive to grain fields.

The lory is a species of parrot having an extensible tongue for taking the nectar of flowers.

In New Zealand occurs the kea, an olive-green parrot which has fallen from its fruit-eating habits to attacking and killing living sheep, thrusting its powerful beak into the fat which surrounds the kidneys.

Lovebirds are tiny African parrots, no larger than sparrows, but of pretty colors. They receive their name from the affection which they show to each other. They are frequently kept as cage birds.

Parrots, macaws, cockatoos, and their allies form the order Psittaciformes. Scientific name of gray parrot, Psittacus erythacus; Carolina paroquet, Conuropsis carolinensis carolinensis; Louisiana paroquet, Conuropsis carolinensis ludovicianus; blunt-tailed parrot, Chrysotis amazonicus; thick-billed parrot, Rhynchopsitta pachyrhyncha; blue-and-yellow macaw, Ara ararauna; red-and-blue macaw, Ara macao; sulphur-crested cockatoo, Cacatua galerita; funeral cockatoo, Calyptorhynchus funereus; kea, Nestor notabilis; Australian lovebird, or budgerigar, Melopsittacus undulatus.



Painting by Marshall Smith

See text on following page

PROMINENT MEMBERS OF THE PARROT FAMILY

LIBRARY.

PROMINENT MEMBERS OF THE PARROT FAMILY



KEY TO PRECEDING COLOR PLATE

ARROTS have been called the "birds with three hands," and those who have watched a parrot clinging tightly to a perch with one claw, manipulating a banana with the other, while he skilfully peels the fruit with his beak, will understand the meaning of that phrase. Claws and beak-those are among the chief distinguishing features of the parrots. They can move one of their claws around to grip an object either from the front or the back, and the upper half of the beak, unlike that of ordinary birds, is hinged like the lower half, so they can twist and handle things most eleverly in their

mouths. The hard thick tongue aids in these operations like a deft finger. Despite these traits which they have in common, the parrots display among themselves wide contrasts in size and coloration. A number of different types are represented on the preceding page and can be identified through the key-picture here.

The Rose Cockatoo (1) represents a type that varies greatly in coloring, but is distinguished by the head crest. The little Love-Birds (2), cuddling closely as they watch the cockatoo scold, are the midgets of the parrot tribe. The giants of the tribe are represented by the great Red Macaw (4) who is balancing himself skilfully with his long tail as he nibbles a morsel of food. Perhaps the most intelligent of the group is the Green Amazon parrot (3). He is the best known in America of those that can be taught to talk.

In their capacity to quarrel and make up, to snatch things from one another at one moment and "go shares" the next, to be surly and clownish by turns, the parrots remind us of monkeys. But let any enemy appear to threaten a nest in a parrot community and they all rally to fight him off with beak and claw.

PARSNIPS. The parsnip (Pastinaca sativa) is a hardy biennial plant—that is, it forms its fleshy carrot-shaped root the first year, but does not produce any seed until the second summer; then the plant, springing up quickly from the root, sends a branching stem up among the leaves, topped with many greenishwhite little flowers. The root, which is eaten the first season, is thick and whitish and has a peculiar but agreeable flavor, sweet but slightly acrid. The root often grows to a length of 18 inches and a diameter of 3 or 4 inches at the crown. Besides being cultivated as a vegetable the parsnip is highly valued as a food for live stock, particularly in Europe. The roots usually are left in the ground in the autumn, as they are improved by the frost; when stored they soon shrivel and become tough unless they are kept moist.

In Europe the plant has been cultivated since the time of the Romans. A wild form of parsnip without the thickened edible root still grows as a troublesome weed in waste places of Europe, the United States, and Canada.

PASSION FLOWER. When the Spanish settlers were roaming through South and Central America they found a flower so symbolic of the Crucifixion that they named it the "flower of the Passion." In the fiveparted purple or lavender blossoms with stripes of white they saw the crown of thorns and the five marks of the wounds of Our Lord. The styles were the three nails and the stamens were the hammer that drove the nails into his hands and feet. The floral leaves were the ten apostles, Judas and Peter being absent, the one having betrayed and the other denied his

The leaves were the hands of the persecutors and the clinging tendrils the scourges.

The plant of the North American passion flower is shrubby and climbing, being somewhat troublesome in the southern cotton fields. Some of the South American species are cultivated for the pale yellow berries, of the size of a small apple. The root of some species is poisonous and acts like morphine. Other species are planted that they may crawl and twist over our arbors and verandas.

Scientific name of common passion flower of the Southern Flowers solitary, white or states, Passiflora incarnata. purple, 2 inches across, with 3 bracts beneath the flower; 5-part calyx colored like petals; 5 sepals with which is a crown of numerous rays forming a fringe; 5 stamens; 3 styles and capitate stigmas; leaves alternate, 3-lobed, cordate-ovate, serrate; stem trailing or climbing by tendrils.

PASSOVER. With tears and rejoicing, with song and praise, the Jews through many centuries have celebrated the festival of freedom, which commemorates their deliverance from Egypt. Round the festal board on the eve of the Passover, the family gather to rejoice and thank God for his preservation of their race.

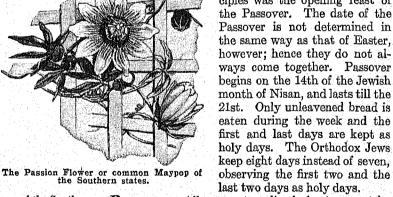
The father of the family sits at the head of the table, which is spread with the best linen and adorned with the best of the family plate. Before him are symbols such as have been used since ancient times to explain the story of the Passover. First of all, there are three flat loaves of matzoth, or unleavened bread. This is a reminder of the haste with which the Israelites were forced to leave Egypt; they had no time to make provision for the journey or to allow their bread to rise, but had to carry the unleavened dough with them and bake it on the way. A roasted lamb bone and a roasted egg commemorate the burntoffering which the Hebrews were commanded to offer. when God promised to pass over their houses and spare their first-born. Another dish contains a portion of horse-radish or other bitter herb, used to represent the bitter life of the Israelites in Egypt; and a paste of nuts, apples, and spices, made to resemble clay or mortar used in building, is a sign of the heavy toil exacted by the Egyptians.

These symbolical dishes are tasted at stated times, while the father reads from the Talmud legends of the forefathers, miraculous stories, prayers, and songs, in which the rest of the family often join.

It is the custom of the youngest child in the family to ask questions about the meaning of the celebration, and these are answered by the father. The whole ceremony is designed to appeal especially to the young, not only in its serious side, but in the games, songs, and stories that make the time pass merrily.

The Jewish Passover falls in the early spring, about the same time as the Christian Easter. The Last

Supper of Christ and his disciples was the opening feast of the Passover. The date of the Passover is not determined in the same way as that of Easter. however; hence they do not always come together. Passover begins on the 14th of the Jewish month of Nisan, and lasts till the 21st. Only unleavened bread is eaten during the week and the first and last days are kept as holy days. The Orthodox Jews keep eight days instead of seven, observing the first two and the last two days as holy days.



PASSPORT. All persons traveling in foreign countries should take passports with them. These are documents issued by their governments certifying to their citizenship and asking foreign governments to give them all lawful aid and protection. Even in the few countries which do not require passports for admission, they are useful as evidence of nationality and proof of identity.

Before a traveler leaves the United States he should obtain a "visa" or official endorsement from the consular agents of the various countries he is about to visit. This is required by all except a

few countries. Some governments grant visas free, but most make a small charge ranging from \$1 to \$10.

Passports are issued by the Department of State at Washington to native and naturalized citizens, at the discretion of the department. The passport includes a description and photograph of the person to whom it is issued, and is good for two years. The members of one family traveling together may make use of one passport unless they intend to visit certain countries where this is not permitted.

Intending travelers should write the passport division of the Department of State at Washington for its most recent circular on the subject. In some countries no citizen may depart without a passport. The word comes from the French passer, "to pass," and port,

a "port" or "harbor."

PASTEUR (päs-túr'), Louis (1822-1895). On the afternoon of June 2, 1881, a group composed of French officials, eminent scientists, delegates from medical societies, Parisian journalists, and a scattering of farmers waited expectantly in a farmyard in the little village of Peuilly-le-Fort. A few members of the party were inspecting a row of dead sheep which occupied one side of the enclosure. The others watched the roadway. Presently one of these called out: "Here he comes!" and the entire group broke into a wild cheer as a small bearded man appeared in the gateway. He bowed, then advanced toward the sheep carcasses. He counted them-25.

"Where are the others?" he asked quickly.

Someone pointed to a nearby pen filled with living sheep. The bearded man counted again-25. Then he turned to the assemblage with a simple gesture

and said: "You see, gentlemen."

It was a moment of triumph for one of the greatest of men-Louis Pasteur, world-famous chemist. Some months before he had announced that sheep and cattle could be protected from the deadly disease of anthrax -the germ of which was discovered by Koch five years before—by first injecting into their blood some of the weakened germs of the disease itself. The bodies of these animals, he said, would in this way develop such a power of resistance against anthrax that it could obtain no hold upon them. His statement met with ridicule. "Prove it," said the veterinarians. Pasteur accepted the challenge. Fifty sheep were placed at his disposal. He vaccinated 25 of them, the others were left in their natural state. Some days later, the entire 50 were inoculated with powerful cultures of living anthrax germs.

"The 25 vaccinated sheep will live," said Pasteur.

"The others will die."

We have seen the result of the experiment. This was only one of the many great achievements of the man, whom the French people once named as the greatest of their national heroes, placing him, in their votes, ahead of Napoleon and Victor Hugo. He extended the method he had used in anthrax to the terrifying disease of rabies or hydrophobia. He succeeded in making animals immune to rabies germs.

and finally saved the life of a boy who had been bitten by a mad dog, and who was the first person who ever escaped death under such circumstances. It was due to Pasteur's discoveries of the effects of bacteria in fermentation and decay that Lord Lister was able to devise the methods of antiseptic surgery. (See Antiseptics). Pasteur also discovered and overcame the germ which was killing the silkworms of France and threatening the entire silk industry. He devised the method of preserving the purity of milk called "pasteurizing." His work laid the foundation for the most of the great life-saving discoveries of the last 50 years in the field of germ diseases. The application of his discoveries in various fields of industry was said by Thomas H. Huxley, himself a great scientist, to have saved France the amount of the billion-dollar indemnity paid by France to Germany in 1890.

Pasteur was born at Dôle, Franche-Comté, where his father was a tanner. After many struggles, he entered the Ecole Normale in Paris. Strangely enough, the graduating diploma of the boy who was to become the greatest chemist of his time was marked "mediocre" in chemistry, perhaps because Pasteur's school work was already distinguished by that independence and originality which contributed so much to his later success. His gospel was the "will to work" and he was never satisfied with tasks half done. In 1868 he was appointed professor of chemistry at the Sorbonne, and in 1888 he became director of the famous center of scientific research known today as the Pasteur Institute.

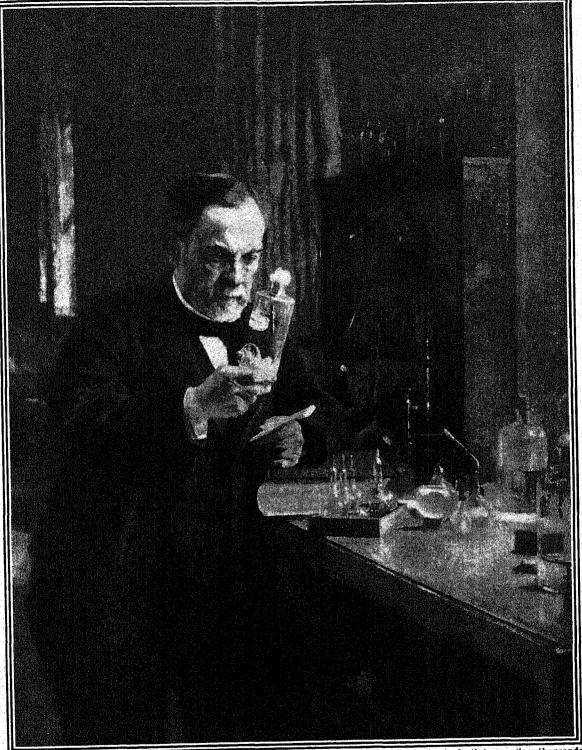
"Pasteurization" is the heat treatment of food products to destroy bacteria which may spoil the product or cause disease. Milk may be pasteurized by either the "flash" or the "holding" method, using the heat of steam or hot water. In the flash method, milk is heated to a temperature of 160° to 185° F., for 30 to 60 seconds. In the holding method, it is heated to between 140° and 148° F., for 20 or 30 minutes. In electrical pasteurization, milk is heated by passing alternating electric currents through it. Cheese and dried fruits

may also be pasteurized.

PATAGONIA. The southern part of the continent of South America, as far as the Straits of Magellan which separate it from the archipelago of Tierra del Fuego, has long been known as Patagonia. Since 1881 the land has been divided between Chile and Argentina. The Chilean section, to the west of the Andes, is a densely wooded strip only a few miles wide. The Argentine section extending 1,000 miles north to the Rio Negro is a tract of more than 300,000 square miles, nearly one-third of the area of the whole Argentine republic. Patagonia was discovered in 1520 by Ferdinand Magellan. A bleak, wind-swept plateau, Patagonia is inhabited by ancient Indian tribes and a few settlers. Sheep raising is the principal industry. (See Argentina; Magellan.)

PATENTS. More than two million patented inventions in less than a century and a half—that is the record of Americans, proverbial for ingenuity. Lists of these contrivances fill many shelves of the Patent Office in Washington, while a force of some 1,300 clerks, examiners, and others is scarcely able

PASTEUR AT WORK IN HIS LABORATORY



"There is no greater charm for the investigator," said Louis Pasteur, "than to make new discoveries; but his pleasure is heightened when he sees that they have a direct application to practical life." Pasteur lived to see the results of many of his own discoveries spread over the world, changing the whole history of biological science, completely transforming the practise of medicine, and, best of all, bringing relief from suffering

and greater security from untimely death to countless thousands of people. No Frenchman's name is more honored to this day than that of this modest chemist whose combined genius and patience made these results possible. We see him here in his small laboratory working with the simple apparatus he used to demonstrate that germs were never "spontaneously generated" but appeared only as the result of "infection" from existing germs.

to cope with the steadily increasing deluge of applications that come flooding in—an average of more than 300 a day, or about 120,000 a year. Yet about 100 years ago an employee in the Patent Office resigned, saying that since inventions had been practically all made and the office must therefore go out of existence in a year or two, he thought it wise

to secure a position elsewhere!

This office is one of the oldest branches of the Federal government, having been provided for in the Constitution itself. In 1790 Congress created the first patent commission, which had to wait three months before an applicant appeared. He was Samuel Hopkins, and he had invented a new process for making pot- and pearl-ashes. Today the United States leads the world in the number of its patents. Patents are granted not only for mechanical inventions and processes, but also for designs and new plant varieties.

Some Queer Inventions

Naturally not all of this vast accumulation of patents represent valuable inventions. One patented device is designed to enable a man buried alive to signal to people outside. Another attempts to render trains collision-proof by means of rails running over the roof so that one train overtaking another would run over the top instead of colliding with it. Hundreds of men and women have clung to the impossible dream of inventing perpetual motion, but since none of them were ever able to furnish a working model, their applications were never granted.

When we compare countries as to the success and importance of their inventions, the result is the same—the United States easily takes the first place. No one has ever labored so hard to save labor as has the American. The greatest of all labor-saving devices, the sewing machine, is chiefly his, and outside of the textile industry (in which England is preëminent) practically all of the great advances in labor-saving machinery have been of his invention—the cotton gin, the reaper, shoe machinery, the type-writer, and typesetting machines. The three most signal advances in electrical application are also to his credit—the telegraph, the telephone, and the incandescent lamp—and the Patent Office contains also a model of Wright's first airplane.

A Standard for all the World

The institution of the American Patent System, established in 1836, created a revolution in the method of granting patents and became the standard for the whole world to emulate. It provided that patents should be issued only after a thorough examination into the usefulness and novelty of the inventions, thus avoiding endless duplication and lawsuits. Greater emphasis was placed upon the right of the inventor to have this invention rewarded, and relatively less upon the benefit which the public would derive from it. Experience has showed that no reward was so fitted to the achievement and so productive of the common welfare as to allow an

inventor a monoply of his invention for a limited time. In 1836 the erection of the Patent Office was begun, and in a short time American inventions increased by leaps and bounds.

The inventor who wants a patent must submit to the Patent Office a written description and drawings of his invention, together with special claims for it, and an application fee. He must also declare upon oath that he believes the invention to be an original one. A search is then made by the examiners at the Patent Office to see whether the idea is really new. If it is so judged, the patent is issued on payment of an additional fee, and the inventor then has the sole right to make and market the invention for 17 years. If anyone infringes upon his rights—that is, makes or sells his patented article—he can compel the infringer to desist and make restitution by bringing suit. Patented articles must always be marked "patented," with the date of issue or serial number.

By international agreement among all the principal countries the citizens of each enjoy in all others the same patent rights as those countries respectively accord to their own citizens. During time of war patents of citizens of enemy countries may be seized like their other property.

The term "patent" is also applied to a title to land

which the government gives the homesteader.

PATERSON, N. J. This important industrial city, 17 miles northwest of New York City, owes its origin largely to Alexander Hamilton, who dreamed of making the United States economically independent of Europe by building up its manufactures. Realizing the possibilities for abundant water power at the Great Falls of the Passaic River, with its drop of 70 feet, he organized the Society for the Establishment of Useful Manufactures. The society founded a town on the site in 1792 for the manufacture of textiles, naming it for William Paterson, then governor of New Jersey.

Cotton was made first. Later, silk dyers were attracted by the natural softness of the river water, and silk manufacture was begun in 1839. Today Paterson is one of the foremost silk manufacturing centers in the Western Hemisphere as well as a large producer of artificial silk. It also has one of the largest airplane-engine factories in the country. Other industries include the dyeing and finishing of textiles, the manufacture of textile machinery, files, submarine cables, men's shirts, linen thread, twine, cordage, structural iron and steel, rubber goods, and underwear. The first submarine was designed here by J. P. Holland, who is buried in a Paterson cemetery.

Paterson is the third largest city in New Jersey. Its industries utilize hydroelectric power to a large extent, and almost no soft coal is burned because silk must be kept clean during manufacture. There are many fine parks and recreation centers. Population

(1940 census), 139,656.

PATRICK, SAINT (389?-461). The patron saint of Ireland, whose special day the Irish celebrate on March 17, was born in what is now England. He lived in southwestern Britain in the troubled days when the Romans were abandoning the island to its fate,



and before the English had appeared, and was educated as a Christian. Then one day, when he was 16 years old, some wild Irish raiders came that way and took him as a slave, carrying him away to Ireland.

After he had served in Ireland for six years as a swineherd, he managed one day to escape in a ship that was going to Gaul (France). For a time he lived in Gaul where he became a monk, and then returned to his home in Britain.

After his return he dreamed one night that a man came to him with a paper bearing these words, "The Voice of the Irish," and at the same time he heard the Irish calling, "We pray thee, holy youth, to come and walk again amongst us as before."

This Patrick decided was a missionary call to Ireland. He returned to Gaul, where he spent 14 years in preparing for his work. He arrived in Ireland with the title of bishop and the pope's blessing, and began the work which was to make him the patron saint of the island.

It has been said that there "were no Christians in Ireland when Patrick began his work and no pagans when he died." This is not strictly true, but he did much to establish Christianity firmly in the island, building churches and monasteries and converting the people. And he did this work while fierce tribal chieftains ruled the land, and there was only a semblance of settled order.

Many legends grew up in Ireland about St. Patrick. You know, perhaps, the story of how he compelled the snakes of Ireland to fling themselves into the sea. There is another story to the effect that when some

converts questioned the doctrine of the Trinity, St. Patrick ended the argument by holding up a shamrock leaf, as an example of "Three in One." It was claimed that at his death, on March 17, 461, there was

no night for 12 days.

PATRIOTIC SOCIETIES, UNITED STATES. Many societies have been formed in the United States to keep alive the memory of its heroic past and to cultivate the sentiment of patriotism in the youths of today. The earliest of these was the Society of the Cincinnati, organized by Gen. George Washington and his officers, May 10, 1783, at the cantonment of the American army on the Hudson River, New York. American and French officers formed the society to keep alive the memory of their comradeship in arms and to perpetuate remembrance of their turning, like Cincinnatus of old, from war to peace when their task was done. Membership goes to the eldest male descendant if worthy; if there is no male descendant, then to male descendants through the intervening female line. Until his death General Washington was president-general, and then Alexander Hamilton succeeded him. There are about 1,500 members at The city of Cincinnati was the present time. named after this society.

The Sons of the Revolution was formed in 1875, and the Sons of the American Revolution in 1889; the Daughters of the American Revolution in 1890, and the Daughters of the Revolution in 1891. The object of all four societies is to perpetuate the memory of ancestors who helped achieve American independence. In addition there are the Society of Mayflower Descendants, the Society of Colonial Wars, the Colonial Dames, the Society of the War of 1812, and a number of other organizations to commemorate events in the country's early history. The Naval Order of the United States, organized in 1890, admits to membership naval officers or their male descendants, or enlisted men who received the Naval Medal of Honor for gallantry.

After the Civil War a number of veteran and commemorative societies were organized. One of the first of these was the Military Order of the Loyal Legion, which was composed exclusively of officers or of the oldest sons of living officers. Among the other Civil War organizations are the Grand Army of the Republic, the United Confederate Veterans, the Sons of Veterans, Daughters of the G.A.R., and Daughters of the Confederacy. Of these, the Grand Army of the Republic (G.A.R.), composed of Civil War veterans of the Union forces, was the most important and once the largest. In 1890 it had 409,489 members. but after that the membership was rapidly reduced by death. Affiliated with the G.A.R. is the Woman's Relief Corps, founded in Denver in 1883 by women relatives of soldiers of the Civil War, its aim being to perpetuate the memory of dead soldiers and to care for their dependents. Other women's societies are the Daughters of the Loyal Legion, the Ladies of the G. A. R., and the Army Nurses of the Civil War. Mexican War veterans formed the Aztec Club of 1847.

Soldiers or sailors who saw service in any foreign expedition make up the strong group called the Veterans of the Foreign Wars of the United States. There is a Military Order of Foreign Wars for the officers, as well as a Military Order of the World War. Men whose valor brought them the Medal of Honor fill the roster of the Army and Navy Medal of Honor Legion. - The first World War led to the founding of several veterans' organizations—the chief being the American Legion (see American Legion). Divisions, as well as armies, have formed commemorative groups. Injured men have banded together in the Disabled American Veterans of the World War. They aim to give mutual encouragement and cheer, as well as to secure financial compensation and medical care from the government. World War veteran societies in the allied nations are affiliated in the Fédération Interalliée des Anciens Combattants, or FIDAC, which hopes that the friendship and understanding between its members will help cement the friendship between their homelands.

The American War Mothers united to do patriotic and relief work. Gold Star Mothers, whose sons lie buried abroad, were given a trip to Europe by Congress, to visit the graves. The Women's Overseas Service League includes women who were on duty abroad,

PAUL, SAINT. Saul of Tarsus, fiery persecutor of the early followers of Jesus, was one day going down the road to Damascus to take prisoner all the Christians he could find there. Suddenly, according to the account in Acts ix, a great blinding light shone down on him, and a voice said, "Saul, Saul, why persecutest thou me?" Trembling, Saul asked, "Who art Thou, Lord?" and the voice answered, "I am Jesus, whom thou persecutest."

Saul, shaken and still blinded, proceeded on to Damascus, a follower of the man whose disciples he had started out to imprison, and "straightway he preached Christ in the synagogues, that He is the Son of God." With such a great change in his convictions it is not strange that the Pharisees, the strict Jewish sect to which he belonged, thought him mad, and the followers of Jesus believed he was a spy. So he left Jerusalem and went to his old home Tarsus, spending three years chiefly in meditation and retirement. Then he took up his mission and went to many other towns in Asia Minor and Greece, establishing churches and gaining many converts to Christ.

Saul, or Paul, was a Roman citizen, the son of parents who were prominent Hebrews of Tarsus. The boy was educated under the most distinguished rabbis of the day at Jerusalem, where he was carefully trained in the strict faith and in the traditions of the Jews. All of the boys of his nationality learned some trade and Saul was taught to make tents, and later, on his preaching tours in various cities, supported himself by tent-making.

He was made a member of the Council of Jerusalem while yet a young man. With his strict training it is no wonder that when Jesus called the Pharisees humbugs and wolves in sheeps' clothing, and said that the strict rules they observed would not save them,

Saul was shocked and angry.

After his conversion, which occurred when he was about 32 years old, he spent some time in meditation, and visited Peter to learn of the life of Jesus, whom, it is believed, he never saw during his lifetime. Then he started out on his great missionary travels. His method was always the same. First he spoke in the synagogue, and when the Jews became hostile he would withdraw and organize a church of the Gentile-Christian order. This aroused the conservative element of the early Christians, who did not agree with Paul that a man could be a Christian without first going through certain Jewish ceremonies. It was Saul, or Paul, as he preferred to call himself after his conversion, who first conceived of Christianity as a world-wide religion, and who formulated the theology of the Christian Church, for his logical mind and training in the law made him supreme in the field of definition and controversy.

He so antagonized the Jews that when he returned to Jerusalem he was seized and thrown into prison, where he was kept two years. Finally he availed himself of his right as a Roman citizen and appealed to the Emperor Agrippa. He was sent to Rome and held there, a virtual prisoner, for two years more. According to tradition he was later arrested and beheaded by order of Nero.

The Epistles of Paul, which form a considerable part of the New Testament, are letters he wrote to his friends and to the various churches. Many of them were written while he was in prison. The Book of Acts tells much about him and his work.

PEA. Will you have your peas early or late, dwarfed or tall, smooth or wrinkled, large or small? A wide range of selection is open in the 200 varieties of garden peas, to say nothing of the many field and ornamental varieties. Fine, fresh, tender peas are a delicacy for the table of the most fastidious; yet from time immemorial peas have been the "meat" or protein food of the poor. The most remarkable thing about peas and the whole leguminous or pod-bearing group of plants to which they belong is their unique ability to produce a nitrogenous food for man and beast and at the same time to enrich the soil in which they grow by nitrogen compounds (see Nitrogen). The cheapest form in which the necessary protein foods can be obtained is in peas or some other legume.

The most obvious difference between the pea and its cousin the bean is the pea's tendril, borne instead of a terminal leaflet on the leaf. Garden peas are eaten green and fresh (with the pod in the case of the sugar pea alone) and are canned in immense quantities, in many sections of the United States.

The coarser, blue-flowered field peas are grown for stock food, both plant and fruit being used as silage. The seeds are also used dry and ground with stockfood mashes, and form the "split pea" used for soup and pea-meal. Sweet peas are an ornamental species developed for the blossoms. Cowpeas or "blackeyed peas" are really beans (see Cowpea).

Scientific name of garden pea, Pisum sativum. Leaves pinnate with a terminal tendril; flowers white, five-petaled, and butterfly-shaped. Some of the most popular varieties are the Alaska (small) and the marrowfat and telephone (large). The chick-pea, whose starchy seeds are much used in Mediterranean countries and central Asia, belongs to another genus of the same family (Leguminosae).

Peabody, George (1795-1869). Though he amassed one of the great fortunes of his time, George Peabody, banker and merchant, is remembered not for his gains but for his gifts. He poured out nearly \$9,000,000 in benefactions in his native United States and his adopted country, England, and received honors and gratitude from both nations.

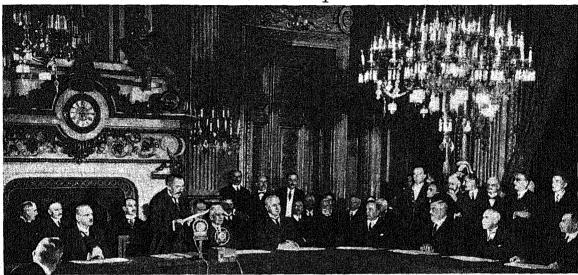
He gave \$2,500,000 for model lodging-houses and other charities in London, but his chief philanthropy was in the interest of education. Into the war-torn, impoverished Southern states he sent the \$3,500,000 Peabody Fund (1867-69) to help bankrupt cities and towns build and run public schools, to encourage the formation of state school systems, and to assist in the consolidation of rural schools. In 1875, this fund established a normal school in Nashville to fit the Southern teachers for their difficult task. This school, now George Peabody College for Teachers, is

endowed with what remains of the fund. To Danvers, Mass., the city where Peabody was born, and where he started clerking in a grocery store when 11 years old, he gave a public library and institute. To Baltimore, where his wholesale dry goods business began the fortune he increased in England, he donated \$1,250,000 for Peabody Institute, consisting

of a library, an art gallery, and a conservatory of music. Harvard, Yale, Peabody Academy of Science in Salem, Mass., and other educational institutions also shared in his generosity.

He died in London in 1869 and after funeral services in Westminster Abbey, the body was brought for burial to his birthplace.

HOW MEN Have Tried to Keep the WORLD at PEACE



Representatives of Fifteen Nations Assembled in Paris to Sign the Kellogg-Briand Peace Treaty

PEACE MOVEMENT. War has always brought sorrow and suffering. But its effects have become more terrible with the advance of civilization, and with the increase of population and economic interdependence of nations. Moreover, with the use of modern science in war, the instruments of destruction have become so powerful that a great war has become a world disaster. The appalling costs in lives and property of the World War of 1914–1918, and the heavy economic burdens and severe suffering it left in its wake, led large groups of people in every country to feel that war must be abolished. (See World War of 1914–1918.)

For centuries a few persons in various countries have worked to bring about world peace, but the modern peace movement is distinctly a product of the period since the French Revolution. The first peace society was organized in 1815 in New York City. In 1843 the first international peace congress was held in London. By 1914 there were in the world 160 peace societies, with many branches and an enormous membership.

Serious difficulties confronted the advocates of peace. The causes of war were manifold. Nations with large and growing populations often went to war to gain territory. Others, developing commercially, went to war to gain colonies where they could buy and sell freely. Some nations went to war to free blood kins-

men from foreign rule, to gain a sure outlet to the sea, or to win some disputed strip of territory. Fear undoubtedly played an important part. When one nation saw a neighboring state growing stronger it feared for its own security. It increased its armaments and perhaps sought allies. Suspicion and distrust followed, and then some trivial incident started a great international conflict. Finally, perhaps the most important single cause of war has been the emphasis which nations placed on their right to do as they pleased. They insisted on their sovereignty and refused to abandon any portion of their independence to the judgment or decision of their peers. They insisted that they were free to fight or to arbitrate, just as they desired. Peace advocates call this condition "international anarchy."

Persons interested in the peace movement have two outstanding objectives in seeking to abolish war: to bring about settlement of international disputes by arbitration; and to bring about limitation and reduction of national armaments. (See Arbitration; Hague Peace Conferences.)

An organized international movement in behalf of arbitration did not begin until the close of the 19th century, although nations had voluntarily tried arbitration earlier. In the United States, in 1881, Secretary of State Blaine suggested that delegates of all American republics should meet to consider how to

prevent wars in the Western Hemisphere. The Pan American Union was ultimately organized, and in 1889 a Pan American Conference declared that arbitration constituted the public law of the American nations. Resort to arbitration, however, remained voluntary.

The effort made at the Hague Conferences of 1899 and 1907 to provide for compulsory arbitration failed. Resort to the Permanent Court of International Arbi-

tration was left voluntary.

At the end of the first World War the Paris Peace Conference drafted the Covenant of the League of Nations. This was later signed by about 60 nations, which thereby agreed to submit their differences to some form of mediation or arbitration before they resorted to war. The League of Nations, in turn, established in 1920 the Permanent Court of International Justice for the purpose of settling international disputes which arose over legal questions. (See League of Nations.) Many countries, including Germany, France, and England, agreed to accept the jurisdiction of this court as compulsory.

Finally, in 1928–29, most of the great countries signed the Kellogg-Briand Pact. By this they agreed to outlaw war as an instrument of national policy and to seek pacific settlement of international disputes.

Efforts to Reduce Armaments

So far, the movement toward the reduction of national armaments has produced mixed results. The first Hague Conference, called by Czar Nicholas II for the purpose of securing an international agreement to limit armaments, achieved nothing. Early in the present century, Great Britain proposed that she and Germany agree to limit the size of their navies, but Germany was unwilling to do so.

A beginning of the compulsory limitation of armaments was finally made in 1919 at the Paris Peace Conference. Germany, Austria, Hungary, and Bulgaria were compelled to agree to observe the military and naval limitations placed upon them by the peace treaties. These limitations, the Allied statesmen at Paris announced, were the first step toward "the initiation of a general limitation of armaments of all nations." Furthermore, the nations which signed the Covenant of the League of Nations recognized that the maintenance of peace required the reduction of national armaments to the lowest point consistent with national safety. The Council of the League had the responsibility of formulating reduction programs.

After ten years of preparation, a disarmament conference met at Geneva in 1932. There, hatred of war and the general demand for peace were met with each country's fear of invasion or of economic strangulation and insistence on armed security. International suspicions proved stronger than international good will, the conference ended in failure.

Short-Lived Limitation on Navies

Naval limitation had for a time proved more successful. At the Washington Conference called by President Harding, a "naval holiday" was agreed upon in 1922 by Great Britain, the United States, Japan,

France, and Italy. In 1930 Great Britain, Japan, and the United States signed another treaty, but Japan did not renew it when it expired in 1936. A treaty signed at the London Conference in 1936 by France, the United States, and Great Britain, and supplementary treaties signed in 1937 by Great Britain, Russia, and Germany did not limit the size of navies, except for Germany. With army expansion already under way, a world-wide navalrace began at once. (See Navy.)

Not only were attempts to limit armaments unsuccessful, but the League of Nations proved helpless to stem the tide of aggressive nationalism in Germany, Italy, and Japan. Disregarding their obligations under the League Covenant and the Kellogg-Briand Pact, these nations seized the territory of weaker states. Finally, in 1939, Europe was again plunged into war when France and Great Britain took up arms to restrain Germany in its career of conquest (see Europe; World War, Second).

Popular Peace Movements

While nations failed in attempts to guarantee peace by pacts and treaties, groups within most nations continued their attempts to promote international good will. Active in the United States were the Carnegie Endowment for International Peace, the World Peace Foundation, the National Council for Prevention of War, and many other organizations, including women's clubs, churches, trade unions, and groups in schools and colleges. These groups emphasized a realistic study of the causes and cures of war, and sought to build up international good will and understanding.

In 1935 the activities of munitions makers in peace and war were widely discussed. Charges were made that many firms had sold arms to both sides in time of war, had blocked disarmament efforts, and had started

war scares to help sell their goods.

As the second World War spread, carrying misery and death to the remotest parts of the earth, more and more people turned their thoughts to the problem of peace. They realized that once the aggressor nations had been subdued and peace had returned, a way must be found to make that peace permanent.

PEACE RIVER. More than 70,000 square miles of fine Canadian farming land lie in the basin of the Peace River. This mighty stream flows more than a thousand miles from its sources in the Rockies to join the Slave River in northeastern Alberta. Through the Slave its waters reach Great Slave Lake and from there pass into the Mackenzie River.

For many years men thought that the Peace River country lay much too far north to be useful for farming; but early in the 20th century experiments proved that fine crops of oats, barley, vegetables, and hardy Marquis wheat could be grown here during the brief

summer (see Wheat).

The soil is fertile and the climate is warmer than might be expected so far north. Some warmth is contributed by the chinook winds from the Rocky Mountains (see Winds). Another factor is the low altitude of the basin. The northern part of Alberta is

several hundred feet lower than the southern part of the province. There is only two degrees' difference in average summer temperature between Fort Vermilion, in the northern part of the Peace River region, and Cardston, 700 miles to the south. With this equality of temperature, crops mature even earlier in the north than in the south of the province, because they have the additional advantage

of very long days of sunshine—as much as 18 hours at midsummer.

part of Canada showed only a few trading Today they are thickly sprinkled with the names of towns and villages which have sprung up with marvelous rapidity. A railway has been built from Edmonton to the Peace River, thus establishing connec-

tion with the vast Mackenzie system of northern waterways: for the Peace River is navigable, except at one obstruction, from the spot where it leaves the Rockies to the Slave River.

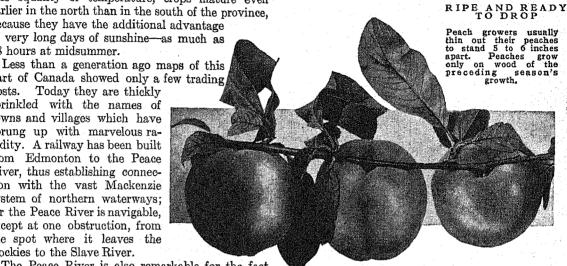
The Peace River is also remarkable for the fact that it takes its rise on the west of the Rocky Mountains but flows eastward through the range by "a veritable gateway of nature"-a valley a mile wide between mountains rising 2,000 to 4,500 feet above it. It is formed in British Columbia by the junction of the Parsnip and Finlay rivers.

PEACH. You might not guess that the peach and almond were first cousins, and yet this is probably the case. Indeed, one variety of peach still has an edible almond-flavored kernel within its hard stone. Nowhere has the peach been found in the wild state. All of the 300 varieties which are grown in the United States are the result of long cultivation.

Popularly peaches are classed either as "freestones" or "clings," but there are many gradations. Some varieties are yellow fleshed and some white, and there is considerable variation in size, flavor, hardiness, and other qualities. The nectarine is a smooth waxy-skinned variety with a firmer and more aromatic pulp.

The peach is a delicate exotic, and has the unfortunate habit of blossoming early, thus exposing the fruit to danger from late frosts. It can best be grown, therefore, where frosts do not come or where cold springs delay the buds until the danger of frost is past, as on the Allegheny hillsides. The chief peachgrowing regions in the United States are an eastern belt southward from Connecticut, particularly the Maryland-Delaware peninsula east of Chesapeake Bay and the Alleghenies west of the Great Valley to Georgia; the eastern and southern shores of the Great Lakes; southern Illinois, Missouri, Arkansas, Colorado, Oklahoma, eastern Texas, and the Pacific Coast states. California and Georgia lead.

Commercially the fruit ranks next in importance to the apple. Because it is so perishable it scarcely entered into commerce until fast trains and refrigerator cars made it possible to market California peaches in Chicago and New York; and even yet



many of the best peaches cannot be marketed except near the place where they are The fact that the peach is exacting to grow, must be picked as soon as it is ripe but before it is soft, and cannot be kept more than ten days or two weeks at most, makes it a luxury rather than a staple.

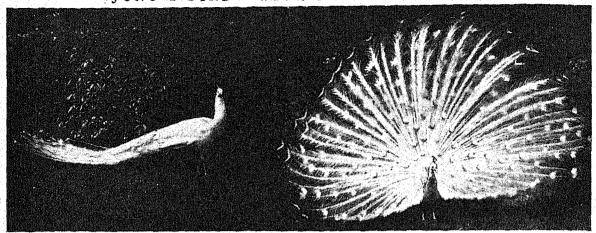
In England and Europe peaches are commonly grown under glass or trained on sunny walls, and while the fruit produced is of the highest quality, the cost is prohibitive for all but the rich.

The peach (Prunus persica) belongs to the same genus as the plum, apricot, and cherry. The tree is small, from 10 to 20 feet high, and bears many branches, the fragrant pink blossoms usually appearing before the leaves. The trees are short-lived and are exposed to many diseases.

PEACOCK. The proverb "as proud as a peacock" does no injustice to the handsome male of this species, which belongs to the pheasant family. His gorgeous plumage combines the metallic shades of bronze, blue, green, and gold, and a crest adorns his head. But his chief glory is the long train of brilliantly marked plumes which grow just above the tail feathers and which, with the quills of the tail, he proudly lifts erect and spreads fanwise to charm the less ornate peahen or the human beholder.

Peafowls are natives of India and Ceylon, where they are common in a wild state. One cock and three or four hens usually constitute a flock. The nest is a rude affair on the ground, or on low branches, and contains about six eggs. Male and female of the young birds are feathered alike until about two years old; then the tail coverts of the male begin to develop their brilliant colors.

.. JUNO'S BIRD' WITH THE HUNDRED EYES



The magnificent plumage of the Peacock has made him a favorite pet since the days of Alexander the Great. It is said that these birds occasionally reach a great age, but their average span of life seems to be from 20 to 30 years.

Domestic peacocks, now common in almost every country, date from very ancient times. To the ancient Greeks the peacock was known as Juno's bird; according to a well-known myth, the strange eyelike markings of the covert plumes were the hundred eyes of the giant Argus, set there by Juno.

In days of chivalry a special feast-dish was the roast peacock served up garnished with all its gaudy plumage. Solemn oaths were sometimes taken "on the peacock."

Under the Chinese Empire a peacock feather was a distinction awarded to mandarins for public services. These birds have long been the symbol of splendor. The famous peacock throne of the Mogul emperors at Delhi was of unparalleled magnificence, for it had

as its background the figure of a peacock with expanded tail wrought all in gold and precious stones.

The Japanese peacock has upper wing coverts of

deep lustrous blue, from which the color term "peacock blue" has arisen. The hen of this species is a grizzled white. It is from this variety apparently that the sacred white peacock of India was developed. Scientific name of common peacock, Pavo cristatus.

PEANUT. The peanut plant is an annual herb of the

pea family. Its fruit is a pod and not a true nut. The taste of the raw seed betrays its pea-like character. Only after it has been roasted does it acquire a rich, nutty flavor.

Peanuts are among the most useful products of the soil. Besides roasting the seeds for eating, we get from them peanut butter and peanut oil for cooking. Peanut oil is largely used also as a salad dressing in place of olive oil, which it closely resembles, and for soap making, oleomargarine, packing sardines, etc. For feeding and fattening stock, the vine is almost equal to the best clover hay. Peanut hulls have the food value of coarse hay, and the thin skin that covers the nut itself can be used in the place of wheat bran in cattle fodder. Finally, the roots of the plant, if left in the soil, enrich it with invaluable nitrogen

products (see Nitrogen). There is thus very little about the peanut plant that cannot be used in some way or other.

The food value of the nuts, long eaten merely as a relish, is only beginning to be appreciated. They contain "per pound more protein than a pound of sirloin steak, plus more carbohydrate than a pound of potatoes, plus one-third as much fat as a pound of butter—an amazing total." Unlike dairy products and meat, the nuts keep without deterioration for years. The United States Department of Agriculture urges the use of peanut meal as a meat substitute, in soups, and mixed with other meals and flours in griddle cakes, muffins, etc.

The peanut plant is remarkable for the way it produces its fruit. After the flowers have fallen, the flower stalks bend down and push into the ground, where the pods or "nuts" develop. From this it is called the groundnut, earthnut, and ground pea or goober in various localities.

The plant (Arachis hypogaea) grows from the Brazilian tropics, where it originated, to Virginia and Argentina, and from Senegal to China. Because it can endure long drouth and grow when rain comes it is of especial value in semi-arid regions, as the southwest of the United States. The yield per acre is from 34 to 60 bushels of nuts in the shell, with a ton to a ton and a half of good hay. If an acre of land can produce 20 bushels of wheat, 40 bushels of oats, or 40 bushels of peanuts, it will yield 154 pounds of digestible protein in the wheat, 149 in the oats, or 186 in the peanuts, and 24 pounds of fat in the wheat, 61 pounds in the oats, and 300 pounds in the peanuts.

Although most of the peanut crop in the United States is used as human food, it has been found very profitable to "sell peanuts as pork." Under this plan, the tops of the plants are cut and gathered for hay, then hogs are turned into the field, where they root out the nuts and eat them, gaining weight rapidly with this diet.

Since about the time of the Civil War the peanut has been grown in the Southern states in increasing quantities. In many cases, especially in the boll-weevil district, it is more profitable than cotton. The American peanut is larger and finer-flavored than any

PEAR. The worst fault of this delicious fruit is the hospitality extended by the tree to various insect pests. The inedible Chinese sand pear is hardier, is immune to the pear blight, and has a wider range of cultivation than the tender, juicy European varieties.

Hybrids between the two kinds have been produced which combine many of the desirable qualities of both, and good results are also obtained by grafting superior fruited varieties on the hardy rootstock of oriental pear seedlings.

The pear tree was probably a native of western Asia, but it is now grown in all temperate climates, with France and the United States as the principal producing countries. Among American orchard fruits pears rank fourth in importance. From New England to the Great Lakes, in California, and also in portions of Oregon and Washington are the principal regions of cultivation in America. In England the pear is trained to grow fan-wise on walls exposed to the southern sun, for the climate there is too cool for the fruit to ripen otherwise. The popular Bartlett pear, widely grown in America, is a variety brought from Europe. where it is known as "bon-chrétien." The small Seckel pear excels in flavor and quality of its The large Kieffer pear, excellent when baked but almost uneatable raw, is one of the best of the oriental hybrids.

Pears are usually picked while they are still hard and imperfectly colored, for if they are left on the tree they become tasteless and gritty; after picking they are stored in a cool place to mellow. Pears are popular as a dessert fruit, and are extensively canned, preserved, spiced, and pickled.

The cultivated pear tree is free from thorns, but on the young wild pear tree the ends of the

branches form sharp spines guarding the fruit of the tree. Many of the disease and insect pests which attack the pear are the same as those which attack the apple, but there is a distinct pear-leaf blight, which is best remedied by spraying with Bordeaux mixture. Like so many of our orchard fruits, the pear (*Pyrus communis*) belongs to the rose family.

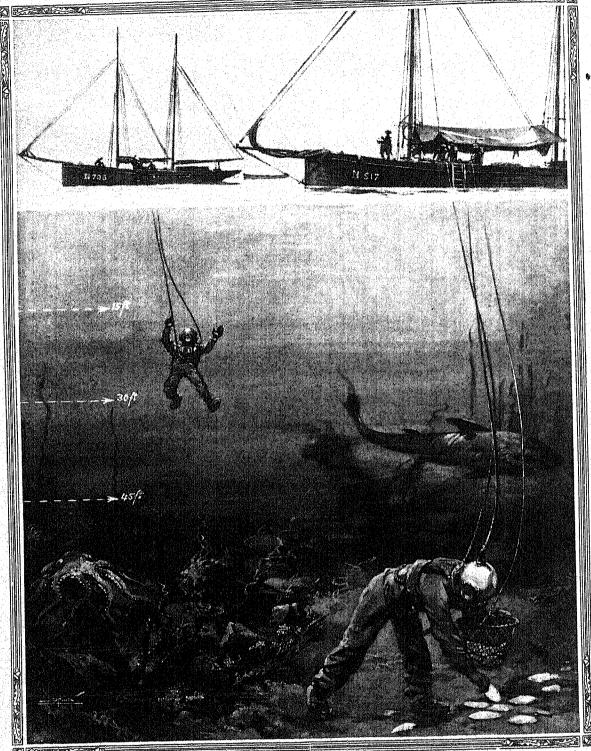
HOW FLOWERS TURN INTO PEANUTS



A peanut plant in bloom, showing also (1) the flower stalk from which the pod develops; (2) a whole pod; (3) a pod opened to show the seeds; (4) a seed; (5) a seed with skin removed; (6) a seed split.

other, but contains less oil than the African nut. Two types chiefly are grown in the United States, the large-podded white or red peanut, with two, three, or even four kernels; and the Spanish or African small-podded peanut which produces small roundish peanuts of milder flavor. The crop in the United States averages about 800,000,000 pounds. China is the chief foreign source of supply.

SNATCHING NEPTUNE'S ONLY GEMS



The pearl is the only precious gem which is obtained from the sea. Unlike mineral gems, such as the diamond, the pearl needs no cutting to improve it. Except for a little polishing it is a finished gem when it is taken from the cyster. The finest pearls come cutting to improve it. Except for a little polishing it is a finished gem when it is taken from the cyster. The finest pearls come from the Far East, many of them gathered by Japanese or Malay divers who simply plunge in, holding a heavy stone which helps to pull them to the bottom. Where the pearl gathering industry is better organized, the men are equipped with diving suits, as you see here. When one of these divers has been down a long time he has to be pulled up in "stages," waving his arms and legs to see here. When one of these divers has been down a long time he has absorbed while breathing the compressed air. Divers, parquicken his circulation and so get rid of the excess nitrogen he has absorbed while breathing the compressed air. Divers, parquicken his circulation and so get rid of the excess nitrogen he has absorbed while breathing the compressed air. Divers, parquicken his circulation and so get rid of the excess nitrogen he has absorbed while breathing the compressed air.

PEARLS. Most shell-covered water animals or mollusks line their shells with a secretion which produces a smooth, whitish shimmering inner surface called nacre or mother-of-pearl, much used for buttons, knife and fork handles, inlay work, etc. This

lining is to protect the delicate bodies of the animals from contact with the otherwise rough covering. Doubtless you have often admired the enamel-like glossiness of the inside of a shell. The secretion is deposited in a series of milky, satiny, transparent films which, hardening, produce a beautiful play of colors.

A pearl is really a calcareous (limestone) deposit of a sick mollusk. Often a grain of sand, a minute marine creature, or other foreign substance finds its way into the shell and irritates the animal. Then the animal, unable to remove it, covers it with successive layers of this membranous substance, and thus pearls are formed. Sometimes the animal is attacked by a parasite boring through the shell from the outside. It repairs the damage by depositing its secretion over the hole in the form of a half sphere, thus forming a blister pearl.

Genuine precious pearls and the most valuable mother-of-pearl are produced by various species of pearl oysters of the genus *Meleagrina*, although inferior pearls are sometimes found in the common edible oyster. Since the pearl naturally partakes of the character of the shell, it is useless

to look for pearls of value in the dull opaque shell of the ordinary oyster. Pearl oysters lie on the hard sea bottom at a depth of from 50 to 150 feet. They are collected by divers working in crews. They may be opened on board ship or they may be gathered in boatloads and taken to the beach, where they are spread out to decompose. Afterward they are washed and the pearls are removed carefully with special pincers or hammers. (See Diving; Oysters.)

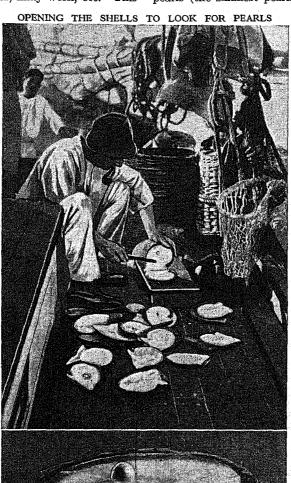
Fresh-water pearls are found in a family of freshwater mussels. Some of the most valuable seed pearls (the smallest pearls) are found in mussels in

the rivers of Scotland, Ireland, Germany, Russia, China, etc. Halfpearls and baroque pearls have been produced by the Orientals since the 13th century by inserting some foreign particle into the lining of a river mussel and allowing it to be coated with nacre. In 1912 the first artificial pearls of perfectly spherical shape were produced by Japanese, but even these can be distinguished from the natural product by the use of X-rays. The best imitation pearls are made of glass beads coated with gelatin and the scales of the bleak, a fish found in European rivers.

The Persian Gulf yields the best grade of pearls. Among other important pearl fisheries are those in the Sulu Archipelago, off the Australian coast, in the Aru Islands, the Pearl Islands, in the Bay of Panama, in the Red Sea, off the Philippines and Burma, and in Ceylon. The largest pearl fishery in America is that of Lower California, from which come the largest and finest black pearls on the market. The largest pearl known is two inches long and four around, and weighs about three ounces.

PEARY, ROBERT EDWIN (1856-1920). "Stars and Stripes nailed to the North Pole.—PEARY."

It was on the afternoon of Sept. 6, 1909, that this dramatic message, flashed by cable and telegraph, thrilled the world. So the long fight had been won at last—the fight of three centuries, in which so many men of different nationalities had given their lives, and in which so many deeds of daring and fortitude had been performed.



What a fascinating task this must be! Who knows but the very next shell may contain a pearl worth a fortune? Below is one of the pearl oysters containing a large "stone." Pearls must be handled with care. Hot water destroys their luster; for this reason pearl rings should always be taken off before washing one's hands. Pearls seem to require the touch of life to keep them brilliant; they have been known to get "sick" and "die" when not worn for a long time.

Peary had actually found the pole on April 6, 1909, just five months before his message was received. He was the only white man of his expedition to reach it. With him on the sledging party, in the last dash, were his negro follower Matthew A. Henson and four Eskimos. For 53 days they and their dog teams

marched across the polar ice-pack, from the last point of land to the pole, and back, a distance of 950 miles. The way was beset with many dangers, yet courage and the wisdom born of long Arctic experience conquered them all.

It was no accident that the long-coveted prize should have been won by Peary. For 18 years he had hoped and worked, returning time and again to the polar regions, always learning from his failures, always paving the way for the final victory.

Born in Pennsylvania and educated at Bowdoin College (in Maine), at 25 he had entered the United States navy, after a civil engineer's training, and in 1887–88 he was chief engineer of the Nicaraguan Canal survey. The year before that, at the age of 30, he had

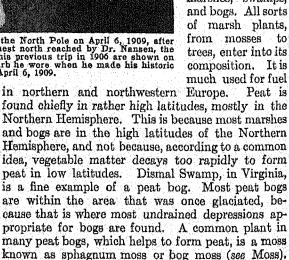
made his first trip to the Arctic regions, visiting the Greenland ice cap. From that day onward the lure of the North was in his blood, the great white spaces haunted him in dreams, and he could never again live at ease. His wife shared his ambition, and spent several winters with him in the Far North, where their little daughter was born. The child was called the "Snow Baby" by the Eskimos, because her skin was so white.

The expedition which finally reached the pole was the eighth which Peary had made into the Arctic regions. They had all been of much scientific value. Peary had explored Greenland, crossing its northeastern corner in one of the most remarkable sledge trips ever made, and had proved it to be an island (1891-92); he had brought home the great Cape York meteorites, the largest then known; he had obtained a vast mass of valuable information in different fields, and he had several times attempted to get to the pole itself, without success. On one of

these expeditions he froze his feet so severely that he lost his toes.

For his final success he received great honors from nearly all the important nations, and the United States Congress gave him a vote of thanks and raised him to the rank of rear admiral. A few skeptics questioned his claims, but the scientific world now almost unanimously accepts him as the discoverer of the North Pole.

PEAT. The making of peat is the first step in the making of coal in Nature's great factory. Peat is a dark brown or blackish mass of partly decayed vegetation formed in marshes, swamps, and bogs. All sorts of marsh plants, from mosses to trees, enter into its composition. It is much used for fuel



Peat deposits grow from 2 to 4 inches a year.



Rear Admiral Robert E. Peary reached the North Pole on April 6, 1909, after seven previous efforts. The points farthest north reached by Dr. Nansen, the Duke of Abruzzi, and Peary himself on his previous trip in 1906 are shown on the globe. Peary is shown here in the garb he wore when he made his historic discovery on April 6, 1909.

can, because of its

thin shell and fine-

flavored kernel, has

long been a prime

favorite in Amer-

ica, and in the past

few years has be-

come the most val-

uable commercial

nut in the United

States. The tree

(Carya pecan) is a

hickory family and

is found native in

the United States

as far north as

Illinois and in

South Carolina,

Georgia, Alabama,

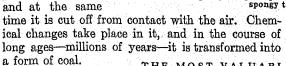
the

member of

Mexico.

The manner of peat formation is as follows: the various marsh plants continue to grow above and decay beneath. The decaying matter below is in

water and forms a heavy mass of water-soaked tissue which, as time goes on, becomes thicker and thicker and more deeply buried beneath the new growth. Under increasing weight above, it is pressed into the rather spongy darkcolored substance known as peat. If the peat is buried deeply beneath sediments, such as mud, it is compressed much more,



Peat bogs tend to preserve vegetable or animal remains which become buried in them. The leaves of plants which compose it are in some cases so well preserved that it is possible for botanists to determine species the which they belonged. In some instances, human and animal bodies have been found in peat bogs in a good state of preservation, even after the lapse of several centuries, as shown by the fact

that with them are

weapons, tools, and armor of the men of the distant past. Peat is cut out in blocks by the peasants in Ireland and other countries and piled in the sun to dry. It burns slowly, gives a dense black smoke, and leaves much ash. Peat compressed into compact bricks forms a much better fuel than in its natural state, but it has come into general use only where the

supply of other fuels is meager. Peat is also used, though not extensively, for the making of paper, for fertilizing soils and for stable litter. PECAN'. The pe-

IRISH PEAT CUTTERS AT WORK



The cutters use a spade, and pile up the blocks to dry. A peat bog is moist and spongy to walk on.

bulk of the market supply comes from native trees along river bottoms, plantations of considerable extent have been set out in Virginia, North Carolina,

While the great

THE MOST VALUABLE NUT OF THE SOUTH

In sections where they can be raised, Pecan trees yield a greater revenue than any other tree.

Mississippi, Louisiana, Texas, Florida, and in central and northern California, and the demand still far exceeds the supply. The pecan will thrive as far south as the Gulf of Mexico, and as far north as central New York, although in the higher latitude crops do not pay cultivation. It is especially well adapted to the sections drained by the Mississippi as far north as central Illinois and central Indiana. and to "two-story

farming," which means planting the trees thinly scattered in fields where quick-growing crops like cowpeas, sorghum, or clover are raised for pigs to harvest.

The trees begin to bear a few nuts the third year. but not until the tenth or twelfth year can commercially valuable crops be expected. An annual yield of 50 to 100 pounds per tree is satisfactory and the yield may be larger, depending on the size and age of the tree. Under favorable conditions the trees will live to a great age, and there are, living and bearing in Texas and other Southern states, trees that are said to be 300 years old. There are about 100 different varieties, many being cultivated improvements of the native tree. The nut grows in a husk or outer shell very much like a hickory nut and falls from the opened husk when ripe.

The pecan meats of commerce are shelled by machinery. The nuts are fed down from a hopper, seized singly between clamps at either end, and cracked. The rapid fingers of girls and women pick out the meats and sort them. Into one barrel go the perfect meats, into another the broken ones.

This piglike animal of the New World PEC'CARY. is sometimes called the muskhog, from the presence of a large gland on the rump which emits a powerful odor. There are two species. The more northern or collared peccary occurs as far north as Red River in Arkansas, and ranges south to Rio Negro in Argentina. This species is about three feet long, occurs singly or in small herds of eight or ten, and is comparatively harmless. The white-lipped peccary is about 40 inches long, and like the collared peccary is covered with thick bristly hair; its range is between Paraguay and British Honduras. White-lipped peccaries occur in herds of 50 to 100 or more, and when attacked fight fiercely with their small but sharp tusks. Both kinds live on roots, fruits, worms, and the like. In cultivated districts they do some damage to crops, but, on the other hand, are of service to the farmer in destroying reptiles. Scientific name of collared peccary, Dicotyles tajaçu or torquatus: of white-lipped peccary, Dicotyles labiatus.

PEEL, SIR ROBERT (1788-1850). "Here comes a Bobbie," shouts the mischievous London street urchin when he sees a policeman approaching, and a lad in Dublin in a similar situation may cry out, "There's a Peeler." Both of these nicknames for the blue-coated officer of the law come from the name of Sir Robert Peel, the British statesman who first organized the London police force (1829) and also the Irish constabulary.

This man, the son of a rich cotton manufacturer, a graduate of Oxford University (1808) with the highest honors attainable, and twice prime minister of Great Britain, was the author of many epochmaking measures. And yet he entered Parliament in 1809, at the age of 21, as a Tory who believed in the established order. This was the time when England, in arms against Napoleon, was opposed to all change because of fear of the radicalism of the French Revolution. After the close of the war this feeling wore away, and the march of political progress went on.

When Peel was in the Duke of Wellington's cabinet, in 1829, he proposed and carried through the Catholic Emancipation Bill, giving Catholics the right to become members of Parliament and hold other offices

(see O'Connell, Daniel). This was a complete reversal of the former positions of Peel and Wellington and it almost split the Tory party; but Peel and Wellington believed that it was the only measure that could preserve peace in Ireland.

Peel while out of office opposed with all his might the great Parliamentary Reform Bill of 1832 (see Russell, John). In the years of Whig administration that followed he devoted his energies as a member of Parliament to strengthening the Conservative party, as the Tories were now beginning to be called. As the recognized head of that party, he was prime minister in 1834-35; but as the Whigs still had a majority in the House of Commons, he soon resigned.

By legislation restoring specie payments (1823) and other measures, Peel had already won the reputation of a financier and statesman of the first rank. His great opportunity for constructive reform came in his second ministry (1841–46). Tariff duties were lowered, laws limiting the employment of women and children in mills were passed, foreign relations with France and the United States were improved, and a new charter was passed for the Bank of England.

Then came the crowning act of Peel's career, in 1846. Because of a potato famine in 1845 thousands in Ireland faced starvation. For a number of years an Anti-Corn Law League in England had been agitating to secure the repeal of the import duties on grain, in order to cheapen food; but the Conservative party, largely made up of landlords, had opposed the measure. Although Peel was a "free trader" on all else, on grain he had hitherto followed his party. But now "famine forced his hand," and with the aid of the Whigs he repealed the Corn Laws, as a relief measure for Ireland. Many of Peel's followers deserted him, and he was soon defeated on a measure in Parliament and forced to resign as prime minister. Though he had "lost a party, he had won a nation," and for the remaining four years of his life the liberal measures passed by the Whigs were largely due to his support. When he died, from the effects of a fall from his horse a few years later, the common people felt that they had lost a friend who had given them "bread unleavened with injustice," and all England recognized the loss of a great statesman.

PEGASUS (pĕg'à-sŭs). When Medusa was slain by Perseus, there sprang from her body, according to the old Greek story, the winged horse Pegasus (see Perseus). Bellerophon caught and tamed Pegasus by means of a golden bridle which the goddess Athena (Minerva) presented to him, and mounted on his back was able to slay the Chimera, a fire-breathing monster, part lion, part goat, and part dragon.

Pegasus remained the faithful companion of Bellerophon, carrying him wherever he chose. At last Bellerophon impiously attempted to mount up to heaven, but Zeus (Jupiter) sent a gadfly which stung Pegasus so that he threw Bellerophon, who fell to the earth, lame and blind. Pegasus, however, was placed among the stars.

It was said that the sacred spring Hippocrene on Helicon, the mountain of the Muses, was opened up by a blow from Pegasus' hoof. For this gift the winged steed was greatly honored by the Muses. Because of his association with the Muses, Pegasus has come to be regarded as the poets' steed, who bears them aloft into the realms of fancy.

PEKING (PEIPING), CHINA. For nine centuries, with occasional interruptions, Peking was the capital of China. But in 1928 the triumphant Nationalist forces captured it, deposed the nominal president of the Chinese republic, and moved the seat of government to Nanking. To emphasize this break with the past they even changed the name of the city from Peking (which means "Northern Capital") to Peiping ("Northern Peace"). But peace was short-lived, for Peking was the first city seized by Japan at the beginning of its invasion of China in July 1937.

Peking is a city of crowds and huge walls, of mud and dust, of incredible filth intermingled with a strange and ancient oriental beauty, of dreadful hovels and shining temples and palaces. As you walk down a narrow squalid street, groping your way through never-ending streams of yellow humanity, you hear shrill cries of warning, and squeeze yourself against a doorway while a caravan of camels lumbers by. They have come perhaps from far-away Mongolia, across the Gobi Desert, through the Great Wall, bringing to Peking rich wares from the north. They force a path through the tangle of two-wheeled hooded horsedrawn carts and man-drawn rickshaws. A lean barelegged rickshaw puller protests, hurling a volley of insults at the camel drivers, while the stately Chinese merchant sitting in the vehicle looks on un-

moved, his hands folded in his flowing sleeves. To get a good view of Peking one mounts the famous wall of the Tatar City, as the northern portion of the former capital is called. This wall is 42 feet high and nearly 40 feet broad at the top, and marked off at intervals by lofty and imposing watch-towers. It is a relic of the Tatar invasions of the 10th and 12th centuries, and incloses the former Imperial

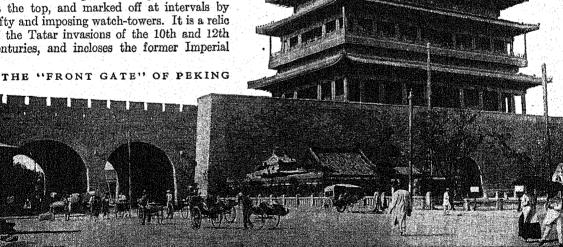
City, as well as the famous Forbidden City where the emperor used to live, and which only a few foreigners had ever penetrated until the Boxer rebellion brought European and American troops to Peking in 1900.

South of the "Tatar City" is the so-called Chinese City, enclosed by a 30-foot wall, built in 1543. Thus Peking is a double city, with an area of about 25 square miles and a circumference of 30 miles.

From the top of the Tatar wall one sees innumerable Buddhist temples and old palaces peering out from groves of trees, in contrast to the low huddled houses in the more crowded quarters. The red, blue, or yellow tiles of the gracefully curving temple roofs put gorgeous splashes of color into the scene, while a touch of silver from some lotus pond flashes in the background.

A better view of the Forbidden City can be obtained from Prospect Hill, an artificial mound 150 feet high topped by five summits, on each of which stands a temple. Near by are the crumbling palaces and homes which housed the former emperors and their courts. Gracefully arched bridges of white marble lead over the flower-bordered pools which dot the parks, and everywhere the oriental love of delicate decorative details is manifest. One of the old imperial buildings housed a priceless collection of royal treasures, which were removed to the interior of the country when the Japanese seized Peking.

In the Chinese City, the most notable building is the Temple of Heaven, with its huge altar, where for five centuries the emperors prayed to Shang-Ti, the Supreme Being or God of Heaven. But more interesting than ancient palaces or temples is a trip through



The famous Chien Men or "Front Gate" pierces the great wall of the Tatar City on the south side. You can see from this picture the amazing thickness of this wall. The structure rising above the wall on the right is one of the "towers" which formerly housed the imperial troops guarding the wall.

A MODERN BUSINESS STREET AND AN ANCIENT TEMPLE



This is one of the few paved streets in Peking. Most of them are unpaved and undrained, and are little more than mud tracks varied by occasional heaps of garbage and foul-smelling pools.

the crowded bazaars. Furs of tiger, leopard, and wild cat are offered for sale, along with costly embroideries and brocades, jade and porcelain wares, strange candies and sugared fruits—all mingled in great confusion.

Within the Tatar City is the Legation Quarter. Here the foreign legations are concentrated, and the banks, clubs, and business houses. It is a self-sustaining city with its own government, police, and public utilities.

Peking's environs also are full of interest. Eight miles away is the famous summer palace of the former imperial family. The grounds are a fairyland of artificial mountains over which wind

intricate pathways and miniature streams and waterfalls. A short railway journey will take the traveler to the Nankow Pass in the Great Wall, through which passes most of the trade between Mongolia and China. In a picturesque, hill-encircled valley, two hours' journey by donkey from Nankow, are the Ming tombs. An avenue three miles in length leading to this ancient burial place of the emperors



This is the altar of prayer for good harvests, a part of the Temple of Heaven. The roof is made of porcelain tiles of an exquisite deep blue color.

of the Ming dynasty is lined with large images carved from solid blocks of marble, representing lions, elephants, camels, horses, military officials, and sages.

For centuries Peking has been the cultural center of China. The nation's great scholars attended its universities and won here the coveted degrees which were the key to high public office. When the Japanese conquered the city, the five national universities moved with their faculties and students into the interior, leaving behind them most of their books and laboratory equipment.

Although Peking is the center of a large Chinese trade it is not industrially

important. Most of its commerce is carried on by railway through the great seaport of Tientsin (see Tientsin). Following the Japanese conquest, the city was made the headquarters of the political section of the Japanese army which creates the puppet governments of China. The companies engaged in the reconstruction of north China also have their headquarters here. Population, about 1,500,000.

male of this species has

a peculiar bony crest on

top of the upper man-

dible, which drops off

later like the antlers of

most breeding area of

this bird is Yellowstone

Lake, Wyoming. Formerly they nested as far

east as the Mississippi

River, but the grega-

rious habits and showy

coloring of this great

pelican proved so great

a temptation for the

hunter that they were

driven to more secluded regions. The common,

or roseate, pelican of Europe is believed to be

a species closely related

The eastern-

a deer.

PELICAN. Nature must have been in a jovial mood when she fashioned the queer-looking pelican. She kinked a vertebra in the bird's neck, so that the

pelican can never raise its face; she gave it a long, weak beak, more than a foot long; then she fastened to the lower mandible a pouch of skin that stretches to a depth of six inches. Some species of pelicans use this pouch as a net in their fisherman trade, scooping fish into it through their wide open mouths.

These solemn-looking birds are fond of company, flocking together in great colonies to bring up their families, and they usually set out in groups on fishing trips. One might wonder what enjoyment the pelican

derives from this close association with his fellows, since he is a silent creature, emitting no sound excepting an occasional grunt.

On land, pelicans are awkward birds, but in the air they perform graceful and magnificent group flights. They swim very well. Their bodies, built with numerous air sacs, are buoyant as cork, and their large webbed feet make strong paddles.

Baby pelicans are naked and blind at birth, and require parental care until they are eight weeks old. They are fed on predigested fish, that is, the parent regurgitates the food for the young from its crop

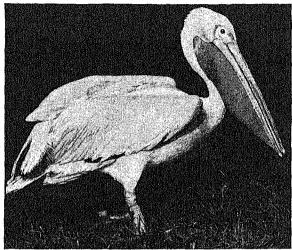
into its pouch. To see the parents feeding these wabbling and ugly babies is a funny sight. The old bird opens its great beak, and the little pelican sticks his head in and helps himself to the fish soup. As the young grow larger they go farther and farther in for their meals until their heads and necks are pushed far within the parents' capacious maws.

There are eleven species of pelicans in the temperate and tropical regions of the world, three species inhabiting America. The larger pelicans measure about five feet in length

and have a wing span of nine feet. Except the spotted-billed pelican of Asia, which nests in trees, these birds place their one to three coarse-shelled eggs in crude nests built on low bushes or on the ground.

Western North America is the home of the white pelican, which frequents inland fresh water lakes as far north as Canada. During the breeding season the

AN EXPERT FISHERMAN



How this White Pelican can gobble fish! Its great skin pouch can hold more than two quarts of them in one mouthful. When not distended, the elastic sac shrivels up under the bill.

to the American white pelican, which it resembles in habits and plumage.

The brown pelican is found in Florida and along the Gulf coast of the United States, and on the Atlantic coast of Central and South America, as far as Brazil. Thousands of these birds nest every year on Pelican Island in Indian River, Fla., which is a government reservation for them. The California brown pelican inhabits the western coast of the United States and Mexico. (For illustration in colors, see Birds.)

Pelicans belong to the family Pelecanidae (order Stegano-podes). Scientific name of white pelican, Pelecanus erythro-

rhyncus; of brown pelican, Pelecanus occidentalis; of California brown pelican, Pelecanus californicus.

PEN. When an ancient Roman wrote a letter he inscribed the words on the wax-smeared surface of thin boards or tablets with a pointed bone or metal stylus. For books and other writings intended to be preserved, the scribe wrote on sheets of papyrus or parchment with a split reed pen (calamus). The reed pen, which is used to this day in Persia and some other Eastern countries, was the ordinary writing imple-

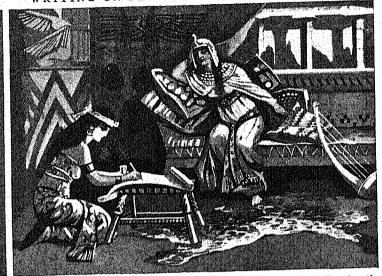
ment in Europe until the introduction of paper made finer pens necessary and quill pens came into use. They were employed so generally that the quill came to be an accepted symbol of the writing profession. These quills were taken



This keeps the White Pelican's feathers clean and healthy. The oil from the preen-gland, which the bird applies to each feather, makes them waterproof.

from the wing of a large bird, usually a goose or swan; and quill pens are still occasionally used. The quill gives us our word "pen" (from the Latin penna, "feather") and the term "penknife," which is still used enough so that several "blanks" with points interlapping can be cut from them. Then the strips are heated cherry red and slowly cooled to soften the metal, Rollers stretch the strips out until they reach the required thinness, and then

WRITING ON PAPYRUS WITH A REED



The ancient Egyptians wrote with a reed called "calamus," which they cut into short lengths and sharpened to a point. In many parts of the East, reed pens are still in use by the natives.

to mean a pocketknife, is a reminder of the days when the pocketknife was used to mend quill penpoints.

Experiments were made in the manufacture of steel pens late in the 18th century. A pen-maker named

Wise produced steel pens in 1803, but they were not satisfactory. Joseph Gillot of England made a successful steel pen in 1820. John Mitchell used machinery in making pens in 1822. These so-called "barrel pens" were tubular like quill pens and had nib and barrel in one piece. About 1828 James Perry introduced "slip pens," somewhat like those of today, for use with holders. It was not until 1858 that the manufacture of steel pens began in the United States. Today more than 100 styles of steel or brass pens are made. The chief American factories are at Camden, N.J. and Philadelphia, Pa. England's pen industries are centered in Birmingham.

The pens are made of the best steel, which is brought to the factory in sheets about 40 of an inch thick—about three times as thick as the finished pen. These sheets are cut into strips just wide machines stamp out the pointed blanks at a rate of many thousands an hour. The manufacturer's name is then stamped on, the central hole for holding the ink is punched, and finally the blanks, which so far have been flat like tiny fence palings, are curved into the familiar pen shape. They now look complete except for the slit down from the ink hole to the point, but the steel is soft and inelastic. A perfect pen, as we know, must be so tough and springy that it opens and closes thousands of times without losing its shape. So the points have to be hardened by heating and dropping

into cool oil, and tempered in cylinders that revolve over a fire. Then they are finished for market.

Gold pens are tipped with iridium or with osmiridium or with an alloy of platinum and iridium to keep

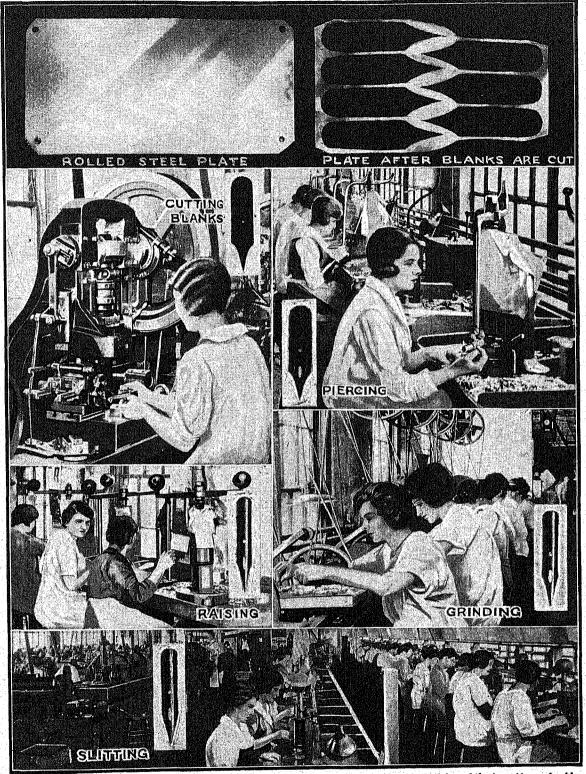
ANCIENT MANUSCRIPTS WRITTEN WITH QUILLS



For more than a thousand years, a period when almost all writing was done by monks, the quills of geese or swans were used. In the 18th century, quills were improved by hardening, usually by dipping in a boiling solution of alum. One of these pens is shown at the left.

the soft metal from wearing away. They are used chiefly in fountain pens, which have grown steadily in favor since their first extensive manufacture in England in 1835; but regularity in the flow of ink

HOW A MODERN STEEL PEN IS MADE



The flat blanks are first stamped out by machine. Machines also cut the little hole which holds the ink, and the two side or shoulder slits which give flexibility. The pen must then be annealed before it is "raised" or rounded between two dies; next the point is slits which give flexibility. The pen must then be annealed before it is "raised" or rounded between two dies; next the point is split by a special machine of very delicate construction. Ground on emery wheels; and final polish, a little lacquer on the tip to prevent rust, and the pen is ready for market.



was first achieved by patents granted to L. E. Waterman in 1884. The modern type of fountain pen has an ink reservoir which keeps the point always supplied, and which can be filled either with a special filler or automatically by drawing the ink up through the point. The barrel is made of hard rubber or synthetic plastics. Some 20,000,000 are manufactured yearly in the United States.

The stylograph pen is also a reservoir pen, but in place of a gold pen it has a blunt-pointed needle or stylus in the tip, which also serves as a valve in regulating the flow of ink.

PENCIL. If you use your share of the lead pencils manufactured in the United States, you use seven every year. In other words, it takes something like a billion of pencils a year to supply the country. To get some idea of what this prodigious number means, imagine all the pencils laid end to end as they stream from the factories. In one year they would form a line long enough to extend three and a half times around the earth!

Think of the forests of timber that are cut down to supply the wood for all these pencils! The only really satisfactory wood for the purpose is the soft, rather "cheesy" red cedar, but the American supply has been so drawn upon that now this wood has Chalks, colored earths, and lead have been used for marking and drawing ever since the days of the Romans. The introduction of graphite for this purpose began in England in the last half of the 16th century. The black mark of the graphite made such a contrast to the pale line of the lead that it was called "black lead."

At first, pencils were made by pulverizing the graphite, compressing it into solid blocks, and cutting tiny bars from these blocks and enclosing them in cases. But since 1795 clay has been mixed with the graphite to produce leads of various grades of hardness; the more clay, the harder the pencil.

Sometimes a little lampblack is added to increase the blackness. The thick doughy mixture is then squeezed by hydraulic pressure through perforations in a plate until it is smooth enough, and finally through a perforation the size of the finished lead. As the long black strings coil up like a wire on the board below, they are nipped off into pieces of the right length, straightened out, and allowed to dry. After drying, the pieces are packed into trays, sprinkled with carbon dust, and baked for several hours until all the moisture has been extracted.

The leads are now ready for the cases, which are made by milling the wood into little "slats" 7 inches

THIS IS WHAT DOES THE WRITING



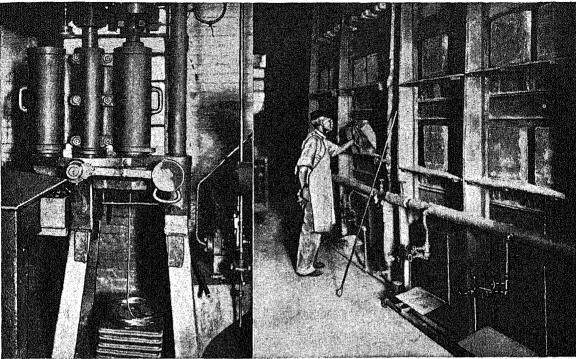
Graphite has to be purified before it can be used in pencils, for in its raw state this form of carbon is usually mixed with other minerals. After being ground and purified, the graphite is pressed into slabs like this.

become exceedingly scarce. Attempts are being made to grow it under cultivation, and buyers have gone through districts where red cedar was formerly abundant and bought cedar stumps and old rail fences and log cabins made of it. Because of this shortage of cedar wood, many of our pencils are now made with a cover of paper strips wound spirally and glued, so that the pencil can be sharpened by unrolling the paper in strips. Cheap pencils are also cased in poorer kinds of cedar and other woods.

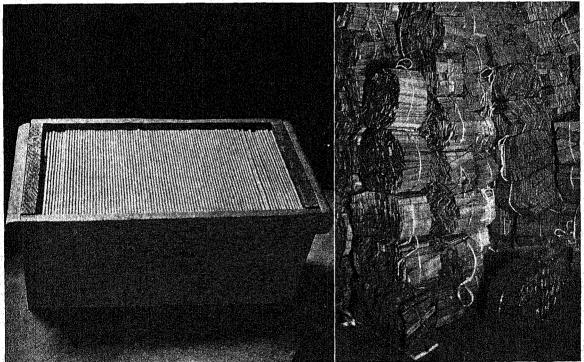
"Lead" pencils, we call them, but the pencils of today do not contain lead, but graphite (see Graphite). Until well into the 19th century, however, lead was used for this purpose, and the name still sticks. long, 2 inches wide, and ¼ inch thick, and cutting six little grooves in them just big enough to hold the leads. The leads are slipped into place, and a cover slat is glued on and clamped. When these "blocks" have dried sufficiently a shaping machine mills each of them into six perfectly formed pencils, which are stained, varnished, labeled, supplied with tips and rubbers, and boxed, all by machinery.

Colored pencils are made by mixing chalk, clay, or wax with coloring matter. Carpenters' and markers' pencils, which are very soft, have a little wax and tallow added to the graphite. A popular form of magazine pencil has a casing of metal, and a lead that is allowed to slip forward at the point as needed.

HOW PENCILS ARE MADE-PREPARING THE "LEAD"

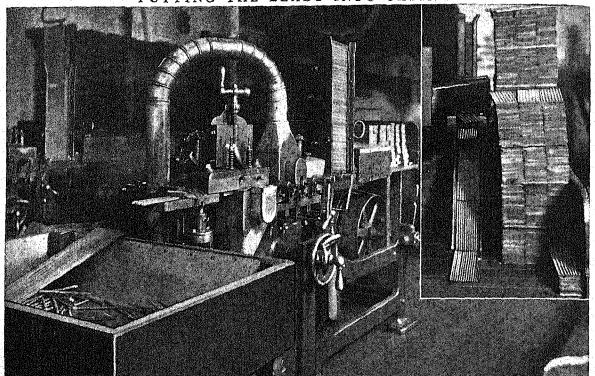


These two pictures show the processes which make the "lead." Purified graphite, clay, and lamp black are mixed into a dough, and the dough is fed into the machine at the left. This machine forces the dough through holes in one plate after another, each hole being smaller than the one preceding. The "dough" emerges from the last hole as a string of the desired thickness. The string is cut into proper lengths. Then the pieces are straightened and baked for several hours in the ovens shown in the right-hand picture.



At the left is a box of baked leads, ready to be made into pencils, and at the right are the bundles of wooden slats from which the covering for the leads will be cut. Each slat has been carefully sawed out to a size which will yield exactly the desired number of "casings," so that there is very little waste in trimming.

PUTTING THE LEADS INTO CASINGS



These two pictures show how the leads and the wood are put together into pencils. In the smaller picture in the upper right-hand corner, the wooden slats are passing through a "grooving machine," which cuts channels just large enough to receive the leads. The grooved slats and leads are then fed into the machine shown in the larger picture. There the grooved sides of two slats are glued together, with leads inclosed, and then the slats are split into separate pencils. These are trimmed down, either round or hexagonal, as desired, and the pencils are delivered to the large box at the extreme left. You can see the pencils made from one set of slats emerging from the left end of the machine.

When a new lead is inserted in the point, its tip is caught in a clutch on the end of a rod bearing a driving stud on one side. This stud is seated in a spiral groove cut along the length of a cylinder inside the

barrel and connected to the cap. Turning the cap turns the cylinder, and the stud of the clutch moves down or up in the spiral, causing the lead to protrude for writing or withdraw into the barrel. Extra leads are carried in a magazine, usually topped with an eraser, all under the removable cap.

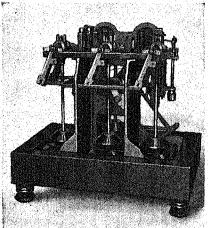
PENDULUM. One day in 1583 a youth of 19 made a great discovery. The scene was the cathedral of Pisa, in which a great lamp swung to and fro on a long chain. The youth timed the vibrations of the lamp by his pulse, and found that no matter how the length of the swings varied, they were always finished in the same time. From this discovery of Galileo's (see Galileo) grew the pendulum—still used in many clocks of our day (see Watches and Clocks).

If we pull a pendulum slightly to one side of its position of rest and then release it, itswings downward under the pull of gravity until it reaches the center. Then its momentum carries it beyond this point, Soon

gravity overcomes momentum, and the pendulum starts back. It swings to and fro until it stops, but the time of each beat or "oscillation" is always the same. The force of gravity is the same on each side of the center, so that the swings take place in equal times, regardless of the weight or material of the pendulum. The only factors affecting the period of the pendulum are the force of gravity and the length of the rod. This swinging of equal arcs in equal times is called "isochronism."

We can control the period of a pendulum, therefore, by adjusting its length. Every pendulum now has a screw below the weight, or "bob," by which it can be raised or lowered on the rod, to regulate the time of beating. Temperature variations also affect pendulums,





Dr. R. A. V. Meinesz devised this apparatus to measure the force of gravity at sea. Mirrors on the pendulums reflect light, and the beams combine into one, swinging like a perfect pendulum no matter how the boat moves about on the surface or is tossed by waves.

because a rising temperature causes the metal of the rod to expand and lengthen, and the pendulum beat is slower. This effect is largely neutralized in "compensating" pendulums. These replace the simple rod with bars of dissimilar metals side by side, each bar being connected at the top to its neighbor on one side, and at the bottom to the other neighbor, out to the end bars. Since the different metals expand unequally, and the arrangement of the bars cancels the upward expansion of one bar by the downward expansion of another, the length of the assembly remains practically unchanged, through wide temperature changes. The alloy invar (see Nickel), which is scarcely affected by temperatures, is often used for making high grade pendulums, particularly for scientific instruments.

Another compensation method widely used has a deep cup of mercury as the bob. This is proportioned so that the expansion of the mercury lifts its mass enough to compensate for the lengthening of the rod.

"Torsion" or twisting pendulums obey different laws. They are weights supported by fine threads of quartz or wire. As the weight turns slowly on the axis formed by the wire it twists the wire, shortening it slightly, and thus lifts itself against gravity. When gravity and the resistance of the wire to further twisting equal the twisting force, the twisting stops and the wire untwists, turning the weight the other way. Momentum carries the weight through the mid-

point—so the arrangement twists one way, then the other, just as a pendulum swings, provided small impulses are given to compensate for frictional losses. A watch balance wheel has a motion to and fro much like a torsion pendulum (see Automatic Devices).

Effects of Latitude and Altitude

A given pendulum will beat faster in high latitudes than at the equator, since the force of gravity is strongest at the poles. A pendulum beating seconds at New York City would be 39.101 inches long; it would be about 39.020 inches at the equator. At New York a "half-second" pendulum would be about 9.780 inches long.

Pendulums of fixed length also beat slower when taken above sea level, since moving them farther from the center of the earth lessens the force of gravity. This effect is so precise that pendulums afford

the best means of measuring altitudes. Those used by the United States Coast and Geodetic Survey are marvels of precision. The probable error in measuring the force of gravity with them does not exceed one part in 200,000. Special forms have been devised for use at sea. Foucault used the pendulum to demonstrate the rotation of the earth, and others to weigh it (see Earth). PENGUIN. Seen from a distance, a colony of these strange sea-birds of the Southern Hemisphere might easily be taken for an assemblage of little men.

OUT FOR A WALK



This is a King Penguin mother escorting her young son on a stroll over the rocks.

They stand erect and flat-footed, often drawn up in long regular files, like soldiers, and they walk with a tread so stately and dignified that the sight is irresistibly comical. In the species known as the king penguin, the resemblance to man is heightened by the coat of grayish-blue which covers the back, set off by the black plumage of the head and the white of the breast, with yellow cravat at throat.

The penguin looks more like "a caricature of a big fat human being than an ordinary diving bird," says the celebrated naturalist William Hornaday; and it was this ludicrous resemblance to mankind that led Anatole France, the great French novelist, to write

LIKE A GROUP OF ALPINE TOURISTS

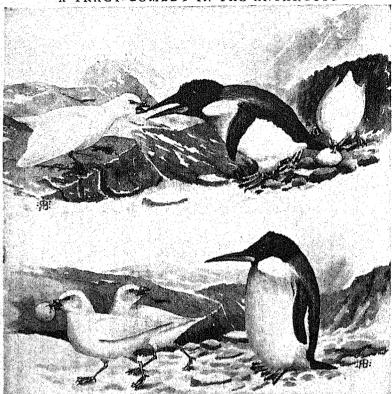


Here is a group of Adelies, most numerous of Antarctic Penguins, standing on the edge of an ice floe, as though gazing at the scenery. Their upright, waddling walk, and arm-like wings, make them seem like so many fat, solemn little men.

his famous story 'Penguin Island'. In this he tells of a snow-blinded missionary who was driven by a storm to a remote shore. Upon landing he was surprised to find, as he supposed, the inhabitants assembled to meet him. As they stood about him, he preached to them, and interpreting their nodding and bowing as signs of assent, he performed the rites

of baptism upon them. Great was the surprise of the good man when he later discovered that he had been speaking to a colony of penguins!

A TRAGI-COMEDY IN THE ANTARCTIC



Of all egg-stealers, undoubtedly the worst robber is the Sheath-Bill, an Antarctic bird which haunts the rookeries of Penguins and Shags. Here you see two Sheath-Bills getting a meal at the expense of a poor helpless Penguin. One of the Sheath-Bills annoys the Penguin, who reaches torward to attack, thus leaving her nest unprotected. The second makes a thrust at the egg with its sharp beak, and the two thieves triumphantly march away with their booty, while the simple-minded Penguin is apparently still unconscious of her loss.

This story might seem more plausible if the fossil penguin of prehistoric ages, which stood 6 feet high, were still in existence. The largest penguins of today, which belong to the emperor penguin species, stand about 3½ feet high, but they weigh about 80 pounds.

Ages ago the penguin could fly as well as any other sea-bird, but today its wings are short paddle-like flappers, entirely useless for flight. Since the bird inhabits only remote lands, in or near the Antarctic regions, where it has few human or animal enemies, it came to spend all its time on land or in the water. Generation after generation it failed to use its wings for flying, and so in the course of long evolution those wings became very small and stiff and lost their long feathers, until now they cannot be moved at the middle joint like the wings of flying birds. But the penguins became wonderful divers and swimmers, using their wings one after the other as a man paddles a cance with a double paddle, and steering with their feet. They also developed a very thick coat of fat to protect them from the intense cold of the regions

where they live. This fatty layer may finally lead to the extinction of the penguin, like the great auk of North America, unless it is protected by laws; for

hunters now kill the birds in enormous numbers and boil them down for oil. Fish is the penguin's chief food, so the fat and oil have a disagreeable fishy flavor.

The haunts of these birds are the islands of the Pacific and Antarctic occans, and the rocky coasts of New Zealand, Australia, and parts of South America. There they nest in great colonies and from their nesting places is collected some of the fertilizer called guano.

The one or two chalky white eggs are laid in a crude nest on the ground. The baby birds are born covered with down, and require care for a long period. In some species not only the parents, but solicitous neighbors feed and care for a single young bird. The grown birds bite savagely when molested, but they show little fear of man, since for generations they have lived in regions where human beings are rarely seen.

Penguins form the family Spheniscidae of the order Sphenisciformes. There are about six genera. Scientific name of emperor penguin, Aptenodytes Inspirostris; of Adelie penguin, Pygosceles adeliae.

PENN, WILLIAM (1644–1718). The despised and persecuted sect of Quakers were greatly elated when William Penn, the talented young son of Admiral Penn, became an

open convert to their religious views, taking so prominent a part in their demonstrations that he was expelled from Oxford where he was then a student. At first the admiral stormed at his son, for King Charles II was about to raise the elder Penn to the peerage but drew back when he heard that the son had become a Quaker. The father's anger, however, was short-lived; he soon forgave him, and the rich and highly placed William Penn became the most prominent Quaker in England.

Likewise, William Penn became the most famous of all the colony-builders of America. His province of Pennsylvania (or "Penn's Forestland") was a princely domain of some 50,000 square miles. The land was granted to him by King Charles II in 1681, in payment of a debt owed by the Crown to Admiral Penn and inherited by William upon the death of his father. William Penn had frequently suffered persecution and imprisonment for his religion in England. Neither could he nor his fellow-sufferers find a place of refuge in any of the established colonies of America,

for the Quakers were regarded as undesirable citizens. It was, therefore, to found a haven for people of all creeds or of no creed that Penn in 1681 sent out the first settlers to his colony of Pennsylvania.

Although the power to make laws, establish courts, and otherwise regulate the affairs of the colony was conferred upon Penn by the king, he established a popular government, giving to the people the right to elect an assembly which should make their own laws.

Penn's most conspicuous success was in his dealings with the Indians. Soon after his arrival in the colony in October 1682, he entered into negotiations with the Delaware Indians. Several treaties of friendship were concluded. The most famous was signed, according to tradition, on June 23, 1683, under a great elm tree on the banks of the Delaware. It provided that the English and the Indians would "live in love as long as the sun gave light." (For picture, see Harrisburg.) For more than 70 years thereafter, while other colonies were suffering the horrors of Indian warfare, Penn's ideal of open and fair treatment kept his territory at peace.

Penn had established a home in Philadelphia, the capital of his colony, and there he would gladly have spent the remainder of his life; but after two years in the colony he was called back to England by business and was detained there for

15 years.

After the Revolution of 1688, which brought William and Mary to the throne of England and Scotland, Penn was suspected of giving aid and comfort to the dethroned James II, and was once arrested for treason. In 1692 he was deprived of his colony, but two years later, the charges against him having been dismissed, he regained Pennsylvania. In 1699 he revisited his province.

Vast changes had taken place during his absence. Twenty thousand people now inhabited the province. Many of them knew nothing of William Penn except that he owned their colony and possessed rights which they wished to exercise. They demanded an even more democratic government than Penn had given them before. He granted their request, and in 1701 signed a charter (the "Charter of Privileges") which remained in force for 75 years—until the Revolution.



WILLIAM PENN Founder of Pennsylvania

Late in the same year, business forced Penn to return to England and leave his beloved colony, which he was never to see again. Troubles crowded fast upon him. He got into money difficulties, and spent nine months in a debtor's prison rather than pay the extortionate claims of a swindling steward. Friends came to his aid and obtained his release. but not until his health had been permanently impaired. His last years were further vexed by quarrels with Lord Baltimore, the proprietor of Maryland, by disagreements with the people of his province, and by the dissipations of one of his sons. He was making arrangements to surrender his colony to the Crown when he was

stricken with paralysis; and so Pennsylvania became the property of his descendants. Their rights, except to private estates, were sold to the Commonwealth of Pennsylvania during the Revolutionary period.

William Penn was the author of a number of works, among which the chief were: 'No Cross, No Crown', a work of Christian piety; 'The Great Case of Liberty of Conscience', an able defense of religious toleration, and 'The Present and Future Peace of Europe', a work which may be said to have foreshadowed the Hague Tribunal and the League of Nations. His 'Fruits of Solitude', a treasury of wise maxims on life and conduct, is still widely popular.

The KEYSTONE STATE, a Titan of INDUSTRY

PENNSYLVANIA. The name "Keystone State" was given Pennsylvania long ago because when the Union was formed it was the "keystone" of the arch, six states lying to the south of it and six to the north.

It still remains the Keystone State, not merely because of its geographical location, but because of its political importance, its immense natural resources, its vast industrial development, and its great population (second only to that of New York).

The largest of the Middle Atlantic states after New York, Pennsylvania is shaped roughly like a

Extent.—North to south, 174 miles; east to west, 306 miles. Area, 45,333 square miles. Population (1940 census), 9,900,180.
Natural Features.—Blue Ridge and Allegheny mountains (Negro Mountain, 3,213 feet); Allegheny Plateau sloping to the west. Principal rivers: Delaware, Susquehanna, Ohio (Allegheny and Monongahela). Mean annual temperature, 50°; precipitation, 42".

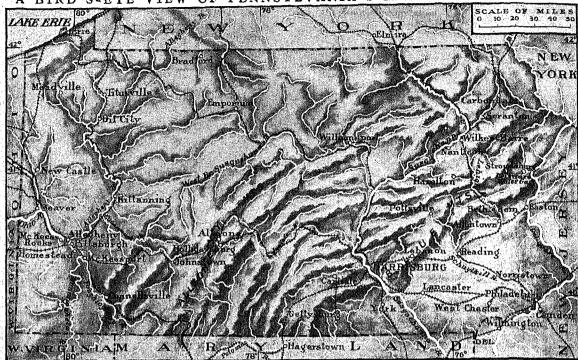
Produc's.—Iron and steel, machinery, petroleum refining, coke, glass, textiles, clothing, chemicals; coal, petroleum, gas, iron ore, cement, clay, stone; wheat, oats, corn, hay, potatoes, tobacco, fruit; cattle, sheep and wool, hogs, poultry and eggs.

Cities.—Philadelphia (1,931,334), Pittsburgh (671,659), Scranton (140,404), Erie (116,955), Reading (110,568), Allentown (96,904), Wilkes-Barre (86,236), Harrisburg (capital, 83,893), Altoona (80,214).

great parallelogram, 306 miles in length by 174 in breadth. The only parts of its boundaries which are not straight lines are the Delaware River on the east, the arc which constitutes the northern boundary of Delaware,

and the slanting shore of Lake Erie, which bounds the northwestern corner of the state. None of the Atlantic states has a surface more varied and in none are the outer ranges of the Appalachian System, extending from northeast to southwest, more widely separated. The water area is but 288 square miles of the total area of 45,333 square miles.

A BIRD'S-EYE VIEW OF PENNSYLVANIA'S HILLS AND VALLEYS



Notice how the railroad builders have profited by nature's engineering; the principal routes follow the valleys carved out through the mountains by the rivers ages ago. The strip below shows the chief occupations of the people.

AGRIF MANUFACTURING

TRADE & TRANSPORTATION

MINING OCCUPATIONS

Four distinct divisions of the state's surface may be noted. The first, the piedmont belt, includes that part of the state between the Delaware River and the Blue or Kittatinny Mountains. The second and third

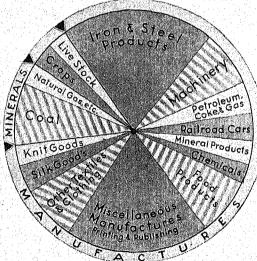
divisions, the Appalachian Mountains and the Great Valley, lie wholly within the main Appalachian system. Throughout this region are found many rugged mountain walls forming gaps or narrows. The Susquehanna and the Delaware break through this chain. The Delaware, cutting diagonally across the Appalachian system, forms the famous Delaware Water Gap. In this division is found also the famous Mount Pocono region, now a summer playground for thousands of tourists. The fourth division begins a little west of the center of the state, and consists of a series of high. rolling table-lands or plateaus known as the Allegheny Plateau. The entire western section of the state, from 1,000 to 1,500 feet above sea level, is everywhere broken by short, fertile

river valleys. Negro Mountain in Somerset County,
with an altitude of 3,213
feet, is the highest point in
the state.

Although only thirtysecond in size among the 48 states, Pennsylvania ranks second among the states in population. If the whole United States were as densely populated as Pennsylvania, the country's population would be four times as great as it is now. The state has always had a comparatively large foreign labor element, but more than 75 per cent of its inhabitants are native born Americans.

Pennsylvania's prosperity is due to the variety of its industries; in this respect it excels both New York





Coal and iron are the foundations of Pennsylvania's chief industries, but the state stands well to the top in many other lines of manufacturing.

and Illinois. It produces more asbestos, mineral paints, coke, ice cream, and leather than any other state in the Union. It makes more than half the country's cotton lace, more than half its chocolate and cocoa, more than one-third of the carpets and rugs and silks, and about one-fourth of the felt hats. The state leads the nation in the production of iron and steel, cement, and glass. With its industries so extensive and varied, it is not surprising that Pennsylvania ranks second in manufactures among the states, being surpassed only by New York.

The "Power House" of America

Coal and iron are the two great foundation stones of modern manufacturing, and Pennsylvania's supremacy in these essentials accounts largely for its riches, although its fertile soil also has contributed vastly to its growth. Nearly two-fifths of the coal mined in the United States, and one-seventh of the world's entire production, comes from the Keystone State. This coal, with the state's excellent transportation facilities, makes it the power house of the richest nation in the world. The entire Appalachian bituminous coal-fields embrace about 70,000 square miles, and about one-quarter of this area lies in Pennsylvania, mainly in the western part of the state. Its anthracite fields-lying chiefly about Scranton and Wilkes-Barre in the Wyoming Valley region—add about 500 square miles to that Pennsylvania total.

The early development of its magnetite and brown hematite iron ores and the opening up of its coal mines first made Pennsylvania an industrial commonwealth. Its supplies of iron ore were limited, but by the time they were exhausted the industries based on them had become so well established that even the discovery of enormous deposits in Michigan and Minnesota could not break the Keystone State's leadership in those fields. Today great fleets of giant barges bring ore from the Lake Superior region to the Lake Erie shore by way of the Great Lakes, and take back cargoes of coal for the Northwest. The iron ore travels by rail to Pittsburgh and other iron and steel manufacturing districts. Pennsylvania also has an abundance of limestone, which, with coal, is essential to the production of iron and steel.

Pennsylvania metal workers have forged some of the heaviest castings ever made, as well as some of the most delicate micrometers used by science to measure within the millionth part of an inch. They have built tremendous machines to test the strength of their steel and iron by subjecting them to strains of millions of pounds; and at the other end of the scale, the state has made watches with balance wheels that measure down to the hundred-thousandth part of a second. Bridges made in Pennsylvania span rivers all over the world; and Pennsylvania-built locomotives run over Pennsylvania rails in the Occident and Orient alike, across arctic wastes and through tropical jungles, through the heart of civilization and along the borders of savage lands.

FIVE PENNSYLVANIA INDUSTRIES



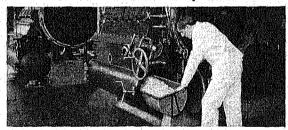
Thousands of these giant looms clattering busily in Pennsylvania, weave one-third of the carpeting made in the United States.



These workers are snipping threads from finished lace; thousands of Pennsylvanians make half of America's cotton lace.



This machine is trimming a hat brim evenly; the Keystone State turns out one-fourth of the country's felt hats.



The huge machines above are grinding asbestos minerals to reduce them to fibers so they may be woven into fire-proof theater curtains, automobile brake linings, and dozens of other asbestos products. Pennsylvania leads all other states in their manufacture.

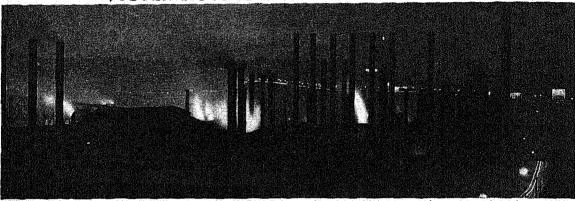
One-seventh of all the world's coal is mined in Pennsylvania. The hazards of the industry are lessened by this safety equipment—a heavy helmet, an electric lamp, and a safety lamp to detect the presence of poisonous gases.



Second only to coal and iron in the economic history of the state are the petroleum and natural gas wells of western Pennsylvania (see Petroleum). The production of crude oil is now small, but the state still has enormous refining interests. The great output of natural gas is one of the foundations of the glass manufacturing industry.

Almost a score of Pennsylvania industries support payrolls running into the millions of dollars every year. The state's thousands of workers find employment in silk, cotton, woolen, and knit goods mills; Commerce flourishes also. The shipping of the world comes up Delaware Bay and River to the wharves of Philadelphia, the state's principal city. And from her western border leads the great Ohio, to float the products of Pennsylvania farms, factories, and mines through the very heart of the land to New Orleans and the Gulf of Mexico. At Erie, on the north, the state touches the Great Lakes, which bring it raw materials and transport its products. The Delaware River which forms the eastern boundary of the state is navigable for steamboats at high tide as

VULCAN'S FORGE IN A MODERN SETTING



Work never ceases in a big steel mill. In this view of a Pittsburgh steel works by night, we see the tracks on the right over which the iron ore and fuel are brought to feed the blast furnaces, those round-topped towers near the tracks. Here the ore becomes molten iron, which is then further refined in the Bessemer converters that make such flares of light in the center of the picture. Or the iron may go to the open-hearth furnaces for conversion into steel ya different process. The tall narrow stacks lead from the open hearths, which use gas produced in making coke for the blast furnaces.

in foundries and machine shops; in printing and publishing houses; in railroad construction and repair shops; in bakeries; in meat-packing plants, tanneries, and cigar and cigarette factories; in factories producing men's and women's clothing; in paper and pulp mills; in glass factories and in factories where textiles are dyed and finished; and in the construction of motor vehicles.

Skilfully Managed Farms

Pennsylvania, however, is not merely a manufacturing, mining, and oil-producing state. It is a great agricultural commonwealth as well; for the skilfully managed farms of the Quakers, Pennsylvania Germans, and others in the eastern part of the state, the limestone soils of most of the mountain valleys, the beautiful grain-producing and wool-growing counties of the southeast, and the fertile pasture-lands of the northwest, more than compensate for the forestcovered and untillable lands in the mountain districts. Wheat, corn, oats, tobacco, fruit, potatoes, and hay, together with wool, live stock, and dairy products are among the staple products. In addition, large quantities of white pine, spruce, and hemlock, as well as other timber, are supplied by the extensive forests which clothe its mountains. Millions of seedling trees have been planted by the State Forestry Bureau to insure that the toll taken by the woodsman's ax shall not too seriously injure the economic resources of the state.

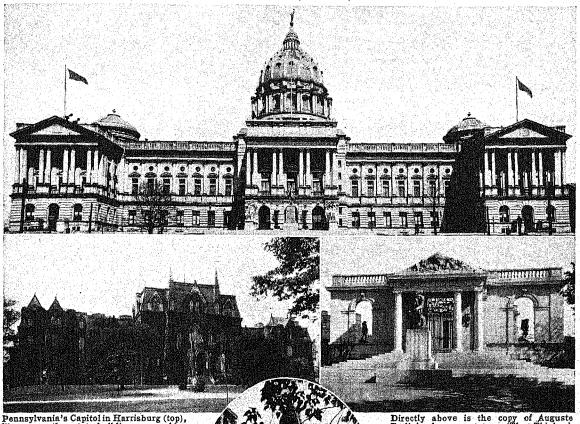
far as Trenton. The Susquehanna, however, on which is located the capital Harrisburg, and which flows out into Chesapeake Bay, is unnavigable because of its many rapids and bowlders. Canals are projected to bring iron ore without transhipment from Lake Erie to Pittsburgh, and to connect the Delaware River with New York Bay.

Canals played an important part in the internal development of Pennsylvania during the first half of the 19th century. By 1830 there were more than 700 miles of canals in the state, with many more miles under construction to offset the commercial advantage New York City had secured by the completion of the Erie Canal in 1825. The railroads put a halt to canal building, and Pennsylvania was among the first American states to build railroads. Today no state in the Union and probably no section in the world has better railroad facilities than does the Quaker State. (See Canals; Railroads.) The roads of Pennsylvania also are among the finest in the country. Here again the state was a pioneer builder, for the first "turnpike" in America, connecting Philadelphia and Lancaster, was started in 1792. (See Roads and Streets.)

A State of Many Busy Cities

Pennsylvania has a larger number of cities than any other state in the Union. Philadelphia, with a population of nearly two million, is the third largest city in the United States, and Pittsburgh, the industrial metropolis of the western part of the state, ranks

HALLS OF GOVERNMENT, ART, AND LEARNING



Pennsylvania's Capitol in Harrisburg (top), like many other state buildings, resembles the national Capitol at Washington. The ivy-covered walls of College Hall, at the University of Pennsylvania (at left, above) tell of the institution's long tradition of scholarship.

tenth (see Philadelphia; Pittsburgh). Erie, on Lake Erie, is Pennsylvania's great lake port. Its splendid harbor is guarded by Presque Isle, a peninsula that stretches for 11 miles along the city's lake shore. Erie is also an important railway center and manufacturing city. Among its leading

products are electrical appliances, kitchen and laundry equipment, and heavy machinery such as steam shovels.

In the center of the state are Altoona, Pennsylvania's great railroad industrial city, and Johnstown, located in the heart of vast bituminous coal beds. Scranton and Wilkes-Barre, on the eastern bank of the Susquehanna River in the anthracite coal region, are mining and manufacturing cities (see Scranton; Wilkes-Barre). In southeastern Pennsylvania are Harrisburg, seat of the state capital, Lancaster, York, and Reading (see Harrisburg; Reading). Lancaster and York lie in the rich agricultural country in the Susquehanna Valley. The metropolis of the Lehigh Valley is Allentown, an important silk-pro-

Directly above is the copy of Auguste Rodin's famous statue, The Thinker, which stands before the outer gafe of the new Rodin Museum in Philadelphia. At the left is part of the campus of Washington and Jefferson College, at Washington, Pa., founded in 1780.

ducing and manufacturing city. Numerous cement companies near Lehigh use the valley's vast deposits of limestone. Near Allentown, on the Lehigh River, is Bethlehem, famous for its steel.

Other important cities are Oil City in northwestern Pennsylvania; Chester, 15 miles south of Phila-

delphia; and New Castle, near Pittsburgh.

Pennsylvania's first constitution was adopted in 1776. The present constitution, adopted in 1873, provides for a general assembly consisting of a senate and a house of representatives. The governor, lieutenant-governor, auditor-general, state treasurer, and secretary of internal affairs are elected for four years. The governor, with the approval of two-thirds of the senate, appoints the other departmental heads.

From the days of the earliest settlers, Pennsylvania has always been active in promoting education. William Penn's charter of 1681 provided for a committee on education, and the second Colonial Assembly in 1683 provided for compulsory elementary education. In 1689 the Friends' Public Grammar School for higher education was opened in Philadelphia, and it still continues as the William Penn Charter School. Other religious groups among the first settlers—Presbyterians, Mennonites, Moravians, and Lutherans—established their own schools, some of which are still maintained.

Today there are more than 30 universities and colleges in the state. The University of Pennsyl-

vania, at Philadelphia, traces back to 1740; it was given its present name in 1791. Pennsylvania State College is at State College. Among the others are the University of Pittsburgh, Temple University, Carnegie Institute of Technology, Swarthmore College, Dickinson College, Washington and Jefferson College, Bryn Mawr College, Lafayette College, Franklin and Marshall College, Bucknell University, and Lehigh University. There are also a number of state teachers colleges and normal schools.

Colonial History

Henry Hudson established the claim of the

Dutch to Pennsylvania and adjacent territory when he cast anchor in Delaware Bay in 1609 while scanning every inlet along the Atlantic coast for a waterway through the American continent to China (see Hudson, Henry). In 1643 the stalwart John Printz, recently arrived governor of New Sweden, moved from Fort Christina at Wilmington to Tinicum Island, just below the present site of Philadelphia. Here he founded New Gottenburg, the first permanent settlement in what is now Pennsylvania.

The thrifty and industrious Swedish settlers cultivated the soil, trapped for furs, and, with their cattle and grain raising, grew prosperous along the Delaware's marshes and meadows. Swedish rule lasted only 17 years, for the Dutch of New Netherland grew jealous of the intrusion and under the leadership of Gov. Peter Stuyvesant, they seized the Swedish colony in 1655. Nine years later the Dutch in turn were ousted by the English, who annexed the territory to New York.

Tales of this beautiful Indian country incited the rich and zealous Quaker leader, William Penn, to seek in America a refuge not only for his persecuted followers, but for people of all creeds. Charles II granted him a huge domain of some 50,000 square miles between New York and Maryland in payment

for a debt of £16,000, which the king had owed Penn's father, then dead (see Penn, William). In 1681 the first band of Quakers arrived led by Penn's cousin, William Markham. In honor of Penn's father they named the land Pennsylvania. Penn himself came the next year with more Quakers, and made his famous treaty with the Delaware Indians which protected the Quakers from the scalping knives and tomahawks of the natives for almost 70 years. (For

The religious freedom and liberal rule of Pennsylvania attracted people of many beliefs and nationalities. Dutch and Swedish were already there when the Quakers arrived. Welsh Quakers settled west of the Schuylkill River at Bryn Mawr, Haverford, and Penllyn, on land that became known as the Welsh Tract.

Great numbers of German and Dutch Mennonites came in 1683, led by Francis Daniel Pastorius, to settle at Germantown, near Philadelphia. Pastorius later signed, and possibly originated, the first petition in America for the aboli-

tion of slavery. These Germans were skilled weavers, printers, lace makers, and silversmiths. By 1690 they had erected the first paper mill in America on Wissahickon Creek. Other German religious groups followed the Mennonites, among them the Dunkers, Schwenkfelders, and Moravians. Nazareth and Bethlehem were founded by the Moravians; the Dunkers built a monastery at Ephrata. Other immigrants pushed through the wilderness to Berks, Montgomery, and Lehigh counties, and their descendants still are known as "Pennsylvania Dutch."

Scotch-Irish, stanch Presbyterians, and able farmers, came early in the 18th century to invade the Cumberland Valley and push on to the wild northern and western frontiers. Hardy and energetic, they were well suited to cope with the savage Indians and the hardships of frontier life. Huguenots from France, Episcopalians, Lutherans, and other religious groups mingled also in Penn's refuge. Soon many flourishing cities were scattered over Pennsylvania, and Philadelphia became the largest city in America.

Pennsylvania's Boundary Dispute

Pennsylvania early became entangled in disputes over its boundaries with Delaware, Maryland, Connecticut, New York, and Virginia. The dispute with Maryland and Delaware was settled in 1763, when



Thrifty Pennsylvania farmers build great barns and work hard to fill them with the products of their rolling acres. But they are never too busy to keep fences and buildings spotlessly white.

AT THE HISTORIC DELAWARE WATER GAP



This gap where the Delaware River breaks through the barrier of the Appalachians was one of the highways through which the first settlers made their way to the fertile Great Valley beyond. Today a railway crawls beside the tumbling river.

Charles Mason and Jeremiah Dixon, two English surveyors, were assigned to draw the southern boundary of Pennsylvania (see Mason and Dixon's Line). An extension of Mason and Dixon's line later settled the claim of Virginia.

Connecticut claimed the land along the Susquehanna River in northeastern Pennsylvania, known as the Wyoming Valley, and a colony of Connecticut Yankees settled here. The "Erie Triangle," claimed by both New York and Massachusetts as their part of the Northwest Territory, was ceded by them to the Federal government, and then was purchased from the United States by Pennsylvania in 1792. Thus Pennsylvania acquired its outlet on Lake Erie.

The long period of friendly relations between the Quakers and the Indians was ended by the struggle between the French and English for control of the rich Ohio Valley. George Washington's first important assignments as a soldier loom prominently in the history of Pennsylvania during the French and Indian War that followed (see French and Indian War; Washington, George). The Quakers, reluctant to join, were forced to fight when Indians raided settlements within 30 miles of Philadelphia.

Again in 1763 the Ottawa Indians, under Chief Pontiac, burned cities and farmhouses, and massacred colonists along the Pennsylvania frontier, and Fort Pitt was saved only by the timely arrival of Col. Henry Bouquet.

Pennsylvania saw the most important events of the Revolution. The first Continental Congress met in Carpenters' Hall in Philadelphia; and in Independence Hall, also in Philadelphia, the Declaration of Independence was signed, and the Liberty Bell rang out its tidings of freedom (see Declaration of Independence). Pennsylvania became an important battlefield of the war after Washington and his tattered forces retreated from Long Island across New Jersey and the Delaware River in 1776. In 1777, Brandywine and Germantown were the scenes of bloody battles before General Howe's British

captured Philadelphia in September. That winter at Valley Forge Washington and his men saw the darkest days of the war.

In 1778 Pennsylvania was the scene of one of the great crimes of the Revolution, the "Wyoming Massacre." Wyoming was an Indian town near the present site of Wilkes-Barre. While most of the men were absent, serving in the American forces, a party of Tories and Indians fell upon the village, burned and pillaged as they advanced, murdered the few men they found, and drove the helpless women and children into the wilderness, where many perished.

In 1787, the Constitution of the United States was drafted at Philadelphia, and Pennsylvania was the second state to ratify it. Philadelphia was the capital of the United States from 1790 to 1800, and the state capital until 1799. That year the state capital was moved to Lancaster, and in 1812 to Harrisburg.

During the Civil War Pennsylvania saw many momentous struggles, among them the great battle of Gettysburg. Chambersburg was burned by Confederate forces in 1864. (See Civil War.)

Some Early Heroes of Pennsylvania

Greatest of Pennsylvania's colonial notables was Benjamin Franklin, who lived most of his life in Philadelphia (see Franklin, Benjamin). An earlier leader was James Logan (1674-1751), who was brought to Philadelphia by William Penn in 1699. Acting as Penn's secretary, Logan was practically governor of the colony for many years. On his death he left a priceless library of some 3,000 volumes to Philadelphia, where it is still preserved in the Public Library. Christopher Sauer, or Sower (1693-1758), a leader in the Dunker colony at Germantown after 1719, published an almanac, a magazine, and books. In 1743 he printed a German edition of the Biblethe first Bible, except for Eliot's Indian version, that appeared in America. Sauer was an expert craftsman who made his own paper, ink, and type. John Bartram (1699–1777) whom Linnaeus described as "the greatest natural botanist in the world," made RED TO THE TELES

a study of the flora of America from Pennsylvania to Lake Ontario, and at his home on the Schuylkill River established the country's first botanical garden, now maintained as a city park. Pennsylvania early produced two noted astronomers, Thomas Godfrey (1704–1749), and David Rittenhouse (1732–1796). Rittenhouse helped lay out the boundaries of Pennsylvania. Godfrey improved the quadrant.

A writer who helped rouse the colonists against unjust taxation by England was John Dickinson (1732-1808); his famous 'Farmer's Letters' did much to stir the feeling that brought on the Revolution. Dr. Benjamin Rush (1745-1813), who was born near Philadelphia, is often called "the Father of American Medicine." He was a signer of the Declaration of Independence. Pennsylvania produced one of the first noted American painters, Benjamin West (1738-1820). (See Painting.) Stephen Girard (1750-1831), who was born in France, landed in Philadelphia when he was 19, and became the richest American of his time. In 1793, when a scourge of yellow fever killed perhaps 5,000 in Philadelphia, Girard enlisted other business men to go with him among the sick and minister to them. On his death he left practically his whole fortune of nearly \$8,000,-000 to various charities. The bulk of it went to establish Girard College for Orphans in Philadelphia. PENSIONS. Regular payments called "pensions" were first granted as royal favors to men who served their king well or did outstanding work in art, literature, and science. In the 19th and 20th centuries, pensions were extended to many other classes. Nations, states, cities, and corporations came to pension faithful workers who had become disabled or too old to continue work. In some cases, pensions were paid to dependents of persons who had died in discharge of their duties. War veterans, teachers, firemen, policemen, government employees, mothers, and aged persons now receive pensions under certain conditions.

War veterans and their dependents were the beneficiaries of the first notable pension system in the United States. Its military pension system was an outgrowth of the first four American wars. Those who had been disabled were the first to be pensioned. Later, on the following dates, all living veterans of these wars, whether or not disabled, were pensioned: Revolutionary War, in 1818; War of 1812, in 1871; Mexican War, in 1887; and Civil War, in 1904. Pensions for all veterans of the Indian wars were voted in 1927. Pensions are also provided for members of the regular military and naval services, as well as for widows and other dependents of soldiers and sailors. The last Revolutionary War widow pensioner was Esther S. Damon, who died in Plymouth Union, Vt., in 1906. Civil War pensions have cost more than seven billion dollars. About 200,000 persons are now receiving pensions as a result of the Spanish-American War. Military and naval pensions are administered by the United States Veterans Administration. On its rolls are more than 800,000 pensioners.

With the intention of replacing the old military pension system, the United States instituted a system of allowances and insurance during the World War of 1914–1918 (see Insurance). In 1924 the World War Veterans Act provided compensation for veterans injured or disabled, while the World War Adjusted Compensation Act was intended to reimburse other veterans for time lost from civilian occupations. The "adjusted service certificates" issued by this latter act were to mature in 20 years, but, in 1936, the so-called Bonus Act redeemed these certificates at face value.

Since 1921 the United States has had a system of retirement benefits for its aged or disabled civil service employees. Compulsory contributions from the salaries of employees provide part of the funds for this purpose. Some cities and states have similar pension systems for their employees.

Railroads and other large corporations have old age and disability pension funds; some of these are partially supported by contributions from employees. Many labor unions maintain pension funds, sometimes in cooperation with employers.

National old age pension systems have been established in several countries. In some they take the form of compulsory social insurance, to which employers, employees, and the state contribute. Other governments bear the entire expense from public funds. In Great Britain the social insurance system includes not only old age pensions, but insurance against unemployment, accidents, and sickness. In the United States, the Social Security Act passed in 1935 provides for federal coöperation with the pension laws of the states (see Social Insurance).

American territories and nearly all states grant public aid to widowed and deserted mothers of dependent children so that they can keep the children at home. The first mothers' aid acts were passed in Missouri and in Illinois in 1911.

PEONY. The peony, with its shining foliage and showy masses of brilliant bloom, is one of the com-

FROM SNOWY SIBERIA



The common White Peony originally came from Siberia, where the Mongolians still use its roots for food.

monest and most effective of our garden flowers, and has been cultivated at least since the days of the Roman author Pliny.

More than a thousand beautiful varieties exist. Nearly all of these are derived from the old-fashioned garden peony, which produces large solitary blossoms, usually

red or crimson, but varying to white, early in the summer; or from the white peony, a native of

Siberia, which bears beautiful white and pink fragrant flowers. The flowers are usually double, but some varieties are single; in size they are often as big as a baby's head. The flowers of the Chinese peonies, a large group of hardy hybrids, are fragrant and double and vary from pure white to crimson and mahogany. All these peonies are herbaceous with tuberous roots.

Less common are the shrubby tree peonies, although they are so beautiful that they deserve to be better known. One species, native to California and Japan. grows from 5 to 6 feet tall, and bears large single or double slightly fragrant flowers, often 8 to 10 inches across. Another tree peony, recently introduced from China where there are hundreds of varieties, has striking yellow flowers, blooming in the late spring. The tree peonies are tender and require protection from

winter cold in many localities. The herbaceous peonies are usually propagated by division of the shoots in the autumn or spring. New varieties are grown from seed, but this is a slow tedious process.

Scientific name of common peony, Paeonia officinalis; of the white Siberian peony, Paconia albiflora; of the tree peonies grown in America, Paeonia moutan and Paeonia

PEPPER. No article of everyday use has a more romantic history than pepper, which is the most important of all spices and takes its place next to salt as a seasoning for food. It was one of the earliest spices known to mankind, but there were times when it was so expensive that one pound was considered a royal present, and it was used only on royal tables or by the very rich.

Taxes and tributes were often paid with pepper. Alaric, king of the Goths, at the siege of Rome in 408 A.D. demanded a ransom of gold, silver, and 3,000 pounds of pepper; and after the capture of Caesarea by the Genoese in 1101, each soldier in the

conquering army received two pounds of pepper as part of his share of the spoils. Its great cost in the Middle Ages was one of the reasons which induced the Portuguese to seek a sea route to India, and after

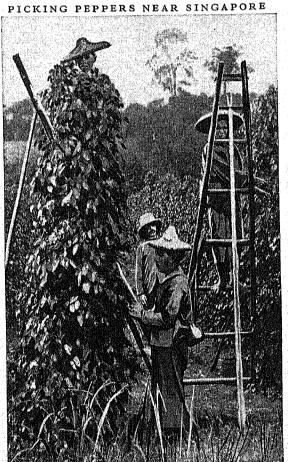
the discovery of the passage around the Cape of Good Hope the price fell considerably.

Pepper plants may be raised either from seed or from cuttings. The latter are said to yield a superior grade and larger quantity of pepper, but are fruitful only for about half as long as a plant raised from seed. The plant begins to bear in its fourth or fifth year, and will continue to bear heavily for 14 or 15 years.

The fruit of the pepper plant (Piper nigrum) plucked before it is fully ripe, dried and ground, yields common black pepper. White pepper is produced by removing the coatings of the ripe black pepper berry before grinding. A native of the East Indies, it is now grown in many tropical countries, especially Sumatra, Borneo, southern India, French Indo-China, Siam, the West Indies, and the Philippines. Singapore is

the chief shipping port.

Other kinds of pepper are obtained from various plants of entirely different families. The most important are the red peppers or "chillies" of the tropical and temperate zones, which belong to the genus Capsicum. The fruit is used green and ripe and in tropical America is considered a necessity of existence. There are many kinds, varying in size and form of fruit. Some of the small varieties are hot as fire, such as the cavenne peppers (named after the city of Cavenne, French Guiana) and the tiny slim tabasco peppers from which tabasco sauce is made; while the large "bell" peppers of the northern markets. which are merely unripe green peppers, are mild enough to make a most agreeable addition to salads. Stuffed with cabbage pickle they make "mangoes," a favorite relish in the United States. When these bell peppers are ripe they are red and hotter, but are still milder than the small varieties. Canned in oil,



The pepper plant is a perennial climbing shrub or vine, which grows wild on the ground or on tree trunks like ivy. In oultivation it is supported on wooden racks or on small trees planted for the purpose. The great bulk of each season's crop in the Orient is collected at Singapore for shipment.

they are known as "pimientos," from the Spanish word for the pepper plant. Stuffed olives usually contain ripe bell peppers which have been steeped in olive oil. Paprika is a red pepper made of M& DEPOS PERCENTAGE AND INTEREST

the dried pods of these mild sweet peppers and can be used far more freely than the pungent cayenne pepper. The so-called Jamaica pepper is not a true pepper but belongs to the myrtle family, and is better known as allspice or pimento. (See Spices and Condiments.)

PEPSIN. One of the most important agents in the digestion of food in the stomach is pepsin. This is a ferment or enzyme, believed by most scientists to be secreted by glands in the mucous lining of the stomach (see Enzymes). It is found in the gastric juice or stomach secretions of nearly all vertebrates.

Pepsin has the power of digesting proteins (tissuebuilding foods like lean meat, peas, and the white of egg), changing them into peptones which are soluble and thus capable of absorption in the alimentary canal; but it is useless in the digestion of fats or carbohydrates. Its action is greatly stimulated by the presence of the hydrochloric acid, which is also secreted by the stomach (see Digestion).

When the human digestive organs become disordered and the proper amount of pepsin is no longer secreted, pepsin is given as a medicine. Commercial pepsin is produced by drying the mucous membrane of the stomachs of pigs, calves, and sheep; it appears as a yellowish powder. It is an ingredient in most digestive preparations on the market. If a healthy stomach is dosed with such digestive preparations, it soon ceases to secrete its own pepsin-in accordance with the law of nature that an unused organ tends to disappear. Pepsin has never been prepared in a pure state, and its chemical composition is unknown.

PERCENTAGE AND INTEREST. Decimal fractions in the hundredths are used so much in business and in other computations that they are given the special name of "per cent," meaning "per hundred" or "by the hundred." The decimal fraction .03 is written 3% and called 3 "per cent" (the sign % being the "per cent sign"). Thus .25 is written 25% and called 25 per cent; $.04\frac{1}{2}$ is written $4\frac{1}{2}\%$ and called $4\frac{1}{2}$ per cent.

To find 3% of a number, the number is multiplied by 3/100 or .03. Thus 3% of $\$600 = 3/100 \times \600 , or \$18; 3% of \$7,220 = \$7,220 \times .03, or \$216.60.

Notice in the problems below how easy it is to find the per cents, by first pointing off mentally two decimal places to get 1% of each number, and then finding the whole number required. In finding 3% of 200, think of 1% as 2.00 (that is, as 2); and 3 per cent as three times that amount, or 6. Find:

2% of 400; of 700; of 900; of 1,100; of 2,200.

Certain per cents are computed more easily when the fractional equivalent is used in place of the decimal. To find 25% of a number it is easier to use the fraction $\frac{1}{4}$ than the decimal .25. To find $33\frac{1}{3}\%$ of a number it is easier to use the fraction 1 than the decimal .33 $\frac{1}{3}$. Thus, 25% of 1,200 = $\frac{1}{4}$ of 1,200, or 300. The most important of these equivalents are:

$20\% = \frac{1}{2}$ 50% =	12	% = 1
40% = } 75% = }		% = 1
$60\% = \frac{1}{8}$ $33\frac{1}{2}\% = \frac{1}{8}$		% = 1
$80\% = \frac{1}{2}$ $66\frac{1}{2}\% = \frac{1}{2}$	87	% = 1
$25\% = \frac{1}{2}$ $16\frac{1}{2}\% = \frac{1}{2}$	14	% = }

Use the fractional equivalent and find:

25 % of 48; of 800; of 1,600; of 20,000.

- 33 1% of 30; of 600; of 1,500; of 33,000.
- 37½% of 40; of 800; of 1,600; of 32,000.

It seems more difficult, perhaps, to find what per cent one number is of another. But it is really a very simple case of division and finding the right place to put our old friend the decimal point (see Decimals). "What per cent is 60 of 80?" really means dividing 60 by 80, or reducing 60/80 to a decimal, thus:

In other words, 60 is .75 of or 75% of 80. See if you can solve the following problem:

If your baseball team plays 24 games and wins 18 of them, what is the percentage of victories? Should it rank higher or lower than a team that plays 33 games and wins 21 of them?

The only difficulty is that people get confused as to "which number is to be divided into which." Just watch for the little word of. What per cent is 17 of 34? 24 is what per cent of 72? The of is always in front of the number you are going to use as a divisor.

What Interest Is

A common use for per cent is in computing interest on money borrowed from a bank, or on that invested in some form. A farmer borrows from a bank \$500 with which to harvest his crops. The bank charges him at the rate of \$25 a year for the use of the money. This charge of \$25, or 5% of \$500, is called "interest." Interest is money paid for the use of money.

The money upon which interest is paid is called the "principal"; the per cent charged is called the "rate" of interest; the time for which interest is paid is called the "term"; the principal with the interest is called the "amount." In the illustration above, \$500 is the principal and 5% the rate. If the farmer returned the money in three months' time, three months would be called the term, and \(\frac{1}{4}\) of \$25 or \$6.25 the interest, and \$506.25 the amount.

To find the interest on a given principal for a given term, the principal is multiplied by the rate, and this product by the time expressed in years or a fraction of a year. We may express it thus:

 $Principal \times Rate \times Term = Interest$

To find the interest on \$1,200 at 6% for six months, the following form, since it admits of cancellation, is a convenient one:

 $\$1200 \times 6/100 \times \frac{1}{2} = \36

In computing the time in days, it is the usual custom to regard 360 days as a year. The interest on \$3,000 at 5% for 18 days may be found by solving the following problem:

 $3000 \times 5/100 \times 18/360 = ?$

At the beginning of the next page is a table, listing various bonds and rates of interest. It will help to fix in your mind practical percentage work if you will complete that table.

Kind of Bond	Interest for 5 Years	Interest for 10 Years	Interest for 20 Years	Interest for 25 Years	
\$50 at 4%	\$10	\$20	\$40	ş	
\$100 at 4%	3	?	?	?.	
\$500 at 41%	?	?	?	ş	
\$1,000 at 41%	?	? .	?	?	

Sometimes stocks, bonds, and other securities drawing a fixed rate are advertised to yield a higher or a lower rate. Take a corporation bond due in 25 years,

with a face or par value of \$100, and paying 4% interest. Perhaps it may be selling "at a discount" (that is, for less than its par value) and may be bought at the moment for \$85 (see Stocks and Bonds). Then it is advertised to yield 5.4%. How can this be? This is because the buyer gets 4%interest every year on \$100, or \$4.00, though he has invested only \$85. At the end of 25 years he will also get the full \$100, which is \$15 more than he invested. In other words, he will get in addition to his \$4.00 interest a return of \$15, which is equivalent to an average yearly return of $\frac{1}{25}$ of \$15, or 60 cents. His \$85 is therefore bringing him the equivalent of \$4.60 yearly. The rate, found by dividing \$4.60 by

85, is 5.41%. If the same bond should be bought "at a premium," say for \$120, and held to maturity, the annual yield would be only $\frac{1}{120}$ of \$3.20, or 2.67%.

How Compound Interest Is Calculated

The foregoing examples have to do only with "simple interest." But anyone who borrows on a life insurance policy and does not pay the annual interest due on the loan has to become familiar with "compound interest." This term means that interest is paid not only on the principal but also on the unpaid interest. At the end of a year, the interest is added to the principal, and the following year's interest is reckoned on the total, thus:

\$100.00 Original principal

5.00 Interest on \$100 at 5% for one year

\$105.00 Principal plus interest at end of 1st year

5.25 Interest on \$105 for 2d year

\$110.25 Total at end of 2 years

Etc., for the length of time it runs.

When savings banks pay interest on deposits, they usually compound the interest every few months. If interest is compounded oftener than once a year, the yearly interest rate may be divided by the number of periods in one year for which it is compounded, and the (accumulated) principal multiplied by this figure.

For example, if the rate is 4%, and the interest is compounded semiannually, the 4% is divided by 2, which gives 2%; if the interest is compounded quarterly, the 4% is divided by 4, giving 1%.

Another way of computing compound interest is to work it out from tables like the one below.

In using the table to find, for example, the amount due on \$500 at the end of eight interest periods, paying 1% for each period, \$1.082857 is multiplied by 500. If the interest rate is 3% paid semi-annually for two years, the number of periods is four, the rate for each period is $1\frac{1}{2}\%$. In this case the interest on \$500 is \$1.061364 multiplied by 500.

COMPOUND INTEREST TABLE

Showing the Amount of One Dollar at the Given Rates for Any Number of Periods up to Ten

No. of Periods, or Times Inter- est is Computed	Per Cent		2 Per Cent	2½ Per Čent	Per Cent	3½ Per Čent	Per Cent
1	1.010000	1.015000	1.020000	1.025000	1.080000	1.035000	1.040000
2	1.020100	1.030225	1.040400	1.050625	1.060900	1.071225	1.081600
8	1.030301	1.045678	1.061208	1.076891	1.092727	1.108718	1.124864
4	1.040604	1.061364	1.082432	1.103813	1.125509	1.147523	1.169859
5	1.051010	1.077284	1.104081	1.131408	1.159274	1.187686	1.216653
6	1.061520	1.093443	1.126162	1.159693	1.194052	1.229255	1.265319
7	1.072135	1.109845	1.148686	1.188686	1.229874	1.272279	1.315932
8	1.082857	1.126493	1.171659	1.218403	1.266770	1.316809	1.368569
9	1.093685	1.143390	1.195093	1.248863	1.804773	1.362897	1.423312
10	1.104622	1.160541	1.218994	1.280085	1.343916	1.410599	1.480244

With the help of the table above find the amount:

- 1. For \$1,000 for eight periods, drawing interest at $1\frac{1}{2}\%$ each.
- For \$100 for three years, drawing semi-annual interest of 2%.
- 3. For \$300 for two years, drawing quarterly interest at 1%.

Interest as Discount

In borrowing money from a bank, it is customary for a person to write a promise to return the money, either at a stated time or when the bank demands it. Such a statement is called a "promissory note."

A manufacturer may wish to borrow \$2,000 from a bank. He writes a note promising to pay the money to the bank at the end of six months. The banker charges him interest in advance. He may charge him 6% of \$2,000 for six months' time, or \$60 interest. This interest the banker deducts from the \$2,000, paying the manufacturer \$1,940. The \$60 interest paid in advance is called "bank discount."

Find the bank discount on each of these notes:

- A note for \$1,000 discounted at 6% for a term of three months.
- A note for \$200 discounted at 7% for a term of six months.
- 3. A note for \$500 discounted at 6% for a term of four months.

KLD THE PLAN

HOW PROMISSORY NOTES ARE MADE OUT

8 100# Chicago, August 26, 19 50
Thirty days after date I promise to pay to
the order ofFirst National Bank of Watertown
One Hundred andno/100 Gollars
Canable at First National Bank of Watertown, Maine
Value received with interest at 7 % per annum Police 19. Reed
John 17. Veled
No. 672 Que September 25, 1950

This "30-day" note shows one of the standard forms used in commercial transactions. Besides the name of the bank and the "maker," all such notes must indicate the amount, the date of maturity, and the rate of interest. You can figure in your head the amount "John R. Reed" has to pay on this note. If the rate were 6% instead of 7%, then the amount of interest for one month would be 1st of 6 or 1st of 1%. On \$100, this would be \$.50. But the rate is 7%, or 1st more than 6%. Therefore you add 1st of \$.50, which is \$.081. As the fraction of a cent is less than 1st, Reed has to pay only \$.58 interest, making the total \$100.58.

4. A note for \$2,000 discounted at 6% for a term of 90 days.
5. A note for \$800 discounted at 6% for a term of 60 days.

Promissory notes are often given at the time a purchase is made or some other debt is incurred. A farmer may buy cattle from a dealer and give him a note promising to pay a certain amount for the cattle at a given time. The cattle dealer may wish the money before payment on the note is due. If this is so, he takes the farmer's note to the bank and, if the reputation of the farmer is a good one, the banker discounts the note for the dealer. When the note falls due, the banker then collects the money from the farmer.

The time that a note falls due is called the "date of maturity." In finding the date of maturity of a note, it is the usual custom, when the time is stated in months, to count by months, and, when stated in days, to count the exact number of days. A three-months' note dated September 1 is due December 1. A 90-day note dated September 1 is due November 30 (29+31+30).

Find the maturity dates of the following notes:

- A three-months' note dated July 2.
 A six-months' note dated January 1.
- 3. A 30-day note dated August 10.

In computing the discount on a note, a banker counts from the day he discounts the note to the date of maturity. If the farmer gave the cattle dealer a three-months' note dated March 15, due June 15, and the cattle dealer had the note discounted March 25, the banker would count the days from March 25 to June 15, and charge him interest for 82 days (6 days+30 days+31 days+15 days). At the rate of 6% on \$500 the banker would charge him \$6.83; for—\$500 × 6/100 × 82/360 = \$6.83.

Deducting the discount of \$6.83 from \$500, the "net proceeds" to the cattle dealer would be \$493.17.

PERCH. Of the many species of these spiny-rayed fresh-water fish, the gamy yellow perch, a favorite of anglers, is the most plentiful and the most important commercially. It abounds in the fresh waters of eastern North America, in the Great Lakes, and the streams of the upper Mississippi valley, and has been introduced by the United States Fish Commission in western lakes and streams. Its back is olive green, the sides golden yellow, with six or eight dark bands, and the lower fins orange red. It reaches a length of one foot and a weight of two pounds. The eggs, about one-twelfth of an inch in diameter, are deposited in strings or bands which sometimes reach a length of seven feet.

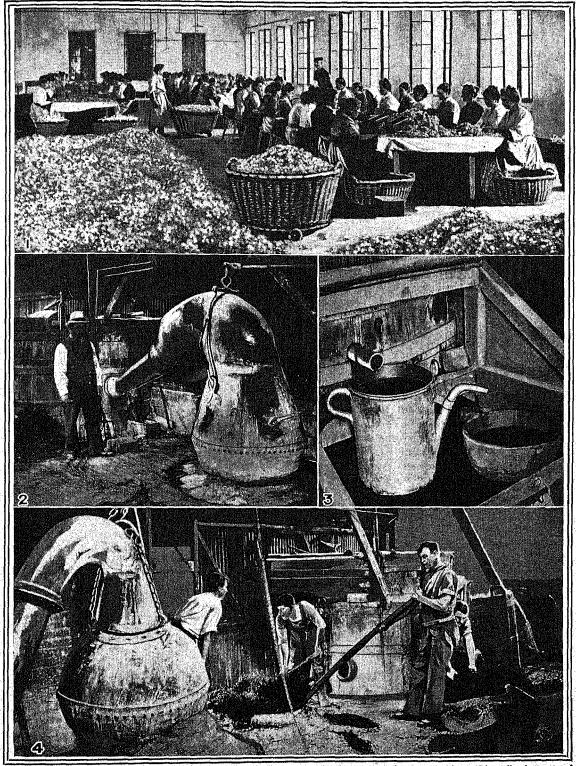
Yellow perch are sought in deep holes under shaded banks, and about bridge piers, sunken timbers, and mill-dams. They travel in schools and each school is composed of fish all of one size. In cold weather they become inactive, concealing themselves in holes. They are carnivorous and feed largely on smaller fishes, including the fry of some more valuable than themselves. The yellow perch of Europe and Asia is closely related to the American species.

A number of spiny-rayed fishes of different families are often called perch, but the name is generally and properly applied to the genus *Perca*, of which there are about 90 species, most of them American. Scientific name of American yellow perch, *Perca flavescens*.

PERFUMES. Every corner of the globe is ransacked to supply the rare and delicate odors used for milady's toilet, and millions of dollars' worth of perfumes and perfume-yielding substances are yearly brought to the United States from Europe, Asia, Africa, and South America.

By far the greater part of the American supply is imported, for only a beginning has been made in the

HOW PERFUMES ARE MADE IN SOUTHERN FRANCE



These photographs were taken during the preparation of oil of lavender, but the process is the same for making all other natural vegetable perfumes. The finest lavender is prepared from the flowers alone, but frequently the stems are also put through the process. 1. Women sorting petals and removing any foreign matter which may have been gathered with the flowers. 2. The petals are boiled in a great retort, from which the vapor is drawn off and condensed in the tank at the left. 3. The distilled liquid emerges from the still. 4. Removing lavender stalks from the still after distillation. This is done by thrusting long rakes down into the boiler, which lies beneath the floor.

The Flowers and Their Fragrant Oils

industry of growing plants and flowers for perfumes in the United States. The sweet scents that perfume our soaps and candies, or that we put on our handkerchiefs, come from far-away Zanzibar, Uganda, Java, Cyprus, China, Tibet, Burma, Peru, San Salvador, and a hundred other distant and romantic places. Millions of pounds of lovely roses, orange

blossoms, violets, tuberoses, and other flowers are gathered and taken to great perfume factories to yield up their fragrance. Odorous woods. seeds, roots, resins, and spices are collected, and certain animals that secrete substances of pleasing aroma are ruthlessly slain for their perfume sacs.

The world contains few more interesting sights

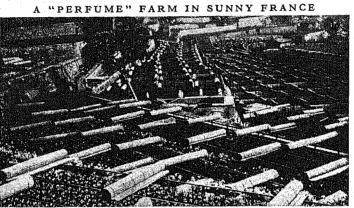
than the perfume-making district of southern France. around Grasse, Cannes, and Nice. Beautiful fields of flowers stretch away on every side, filling the air for miles with their delicate scents. In the fields you see men, women, and children gathering the precious blossoms and heaping them up in great baskets, and along the roads pass streams of wagons, each filled to the top with loads of flowers for the factories. There, each little blossom gives up its tiny drops of fragrant oil, to be bottled and sent, perhaps, to some distant part of the world. It is said that the total weight of the flowers gathered in this district is between 10 and 12 billion pounds a year.

There are two principal classes of perfumes, the animal and the vegetable. Of the four animal perfumes, musk is the most important. It is a reddishbrown substance of the consistency of honey, obtained from the musk deer, an inhabitant of the plateaus of Central Asia (see Musk Deer). It is a powerful and enduring perfume and gives odor to everything in contact with it, or near it. Even polished steel if shut in a box with musk will become fragrant of it. Musk is used in minute quantities to give permanence to other odors that by themselves soon disappear. Its price is now very high, because of the growing scarcity of the animal that produces it.

Ambergris is a secretion of the intestines of the sperm whale. It is a waxy substance of different colors—white, black, yellow, ash-gray, or variegatedand it is frequently found floating in large masses (sometimes 200 pounds) in the Indian Ocean and other tropical seas. Civet comes from glands of the civet cat, a native of Asia and northern Africa. It is

of a clear yellowish-brown color and of the consistency of butter. When civet is pure, the odor, which is the same as that of the narcissus, is unbearable. It is useful in diluted form in soaps and sachets. Castor comes from glands of the beaver. It is dark colored and has a strong lasting penetrating odor which is very pleasant, especially when the perfume is old.

Of the vegetable or plant perfumes. the simplest are those exhaled by dried flowers, and the combination of these with spices. odorous woods, and The fraherbs. gum-resins grant belong here, of which the most important are benzoin, myrrh, storax, and the balsams o f Peru and Tolu. Great quantities of these gums are used in making incense.



This is a farm in the Riviera district of southern France, where flowers are This is a farm in the Riviera district of Southern France, where nowers are grown for making perfumery. Even in such a warm climate, the flower farmer takes no chances. Each night he covers the beds with screens, which you now see rolled up to let the sun shine on the flowers. Special care is needed to develop the highest fragrance in the blossoms.

Most of our perfumes, however, are obtained by removing the fragrant oils from plants by various processes. Those obtained by distilling flowers, bark, seeds, or other odor-bearing substances are called "essential oils" or "ottos," from the Turkish word attar. The active principle of odor-bearing plants is in the sacs or glands; these may be in the rind, as in a lemon or orange; in leaves, as in sage and thyme; in bark, as in cinnamon; in seeds, as in caraway and nutmeg; in the petals, as in the rose and lavender; in wood, as in sandalwood and rosewood. The problem of the perfumer is to get the essential oil as pure as may be without injuring it. Delicacy and care are required in the operations. Sometimes the flower is crushed and soaked in alcohol, as in the case of the iris. Or the oil may be squeezed out by hand, as from citron, orange, and bergamot. Others are distilled, as roses, lavender, rosemary, sandalwood, and ylang-ylang (the flowers of a Malayan tree). Perfumes do not usually consist of a single oil, but of a blend of fragrances.

The most important of these oils is the famous attar of roses, which is obtained by distillation of rose petals with steam or petroleum ether. The industry is centered chiefly in Bulgaria and France, but also is found in Persia, India, and Turkey. An acre of roses yields a ton or more of petals under good conditions, and a ton of petals makes only nine or ten ounces of the oil of roses; that is why the price ranges from \$15 to \$100 an ounce. The odor is so powerful that one drop is enough to give fragrance to a gallon of cologne. Attar of roses is used mainly as an ingredient in perfumes and toilet waters.

For very delicate flowers more subtle means are necessary to capture their fragrance. These processes depend on the power of fats to absorb odors; they are known as the cold process, or *enflurage*, and the hot process or *maceration*. In the cold process, lard, beef-suet, or some other grease is spread out

thinly on glass plates and air is passed over the flowers and to the lard. The flowers are renewed until the fat contains all the perfume it can take up. In the hot process, flowers in linen bags are hung in jars of warm lard or vaseline till the perfume is taken up. The perfume is then dissolved out of the fat with various solvents, such as alcohol, and ether.

Besides these animal and vegetable perfumes, various artificial or synthetic perfumes are made, sometimes by combining chemicals, but generally by the chemical manipulation of plant oils. Some of these synthetic perfumes have a remarkable similarity to natural perfumes, but no chemist has yet succeeded in producing perfumes as delicate as those manufactured by nature.

by nature.

This is partly because the

theoretically simple process of Leader at Athens synthesizing the various aromatic compounds is actually very difficult, and partly because the slightest impurity—one which it may be difficult to detect chemically—may spoil the perfume, as a false note spoils the rendering of a musical composition. A synthetic musk, an artificial violet, and other substances are compounded and used in blending some of the better natural perfumes; they are used also in the cheaper, wholly artificial products, but this has not greatly lessened the demand for the natural perfume bases.

From the earliest times men have prized perfumes and known the art of making them. Perfume bottles are frequently discovered in excavating city sites of the ancient East, and early literatures are full of references to precious sweet-scented oils. In the Middle Ages the Arabs were conspicuous for their skill in the manufacture of perfumes. Thus the idea of sweet odors came to be generally associated with Arabia, as we see in the many references by the poets. After the murder of Duncan, Shakespeare makes Lady Macbeth say:

All the perfumes of Arabia will not Sweeten this little hand.

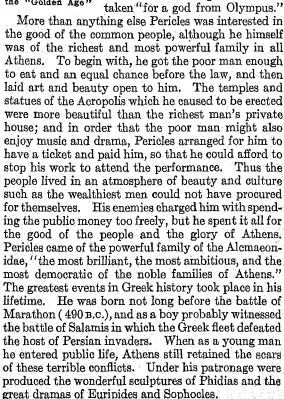
France and Italy also learned early the art of making perfumes, and France is still the greatest growing and manufacturing center. England is unsurpassed for its lavender and peppermint. In the United States, sassafras, peppermint, spearmint,

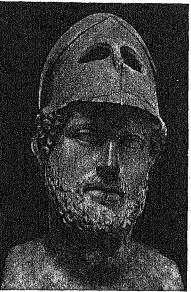
wintergreen, and cedar oils are produced in large quantities, but these are more used for flavoring than for perfumes.

PERICLES (about 493-429 B.C.). When we think of Athens, the greatest city of Greece, at the height of its glory, we think of Pericles, the statesman who

made possible that golden age which bears his name, and who represents to the world the ideal Athenian.

Pericles' power exceeded that of many kings and tyrants, yet he never held the office of archon, which was supposed to be the highest in the state. He was simply one of the ten "generals" (strategi) elected each year by the Athenians to manage their affairs at home and abroad, and he owed his power entirely to his personal ascendancy and his persuasive eloquence. He ruled Athens because the Athenians learned to trust him. For 30 years they reëlected him, and he made their city glorious and never failed them in times of difficulty. When he appeared before the assembly, so serene and quiet was his manner that he might have been





PERICLES
Leader at Athens in the "Golden Age"

Pericles realized his ambition to make Athens, "the queen of Hellas," not only the most beautiful but the most powerful of the Greek states. But he lived also to see the states of the Peloponnesus, under Sparta's leadership, rise against Athens' overgrown power in the Peloponnesian War. The closing years of his life were times of storm and trouble. While Athens was besieged by the enemy without the walls, a terrible plague raged within. For the first time Pericles fell out of popular favor, was deposed from office, and was even fined 50 talents on a charge of embezzlement. Only a few weeks later the people repented and reinstated him with greater powers than before. But the plague, which had made him temporarily unpopular, had left its mark on Pericles himself, and he died in the autumn of the next year.

The speeches of Pericles were not written down and preserved, as were those of Demosthenes and other Greek orators a hundred years later, but Thucydides in his history gives us some idea of Pericles' power as an orator. The funeral oration that he represents Pericles as speaking over the dead in the first year of the Peloponnesian War is especially noble: "Of all cities Athens alone is even greater than her fame. She needs no poet to sing her praises; every land and every sea can furnish proofs of her enterprise and success. Her enemies when defeated are not disgraced; her subjects confess that she is worthy to rule them." In concluding, he says of those who have died in her defense: "To men who fall as they have fallen death is no evil."

PERISCOPE. The deadly submarine gliding unseen beneath the waves, and the soldier crouching in the trench, not daring to raise his head, depend upon the periscope, man's third eye, to tell them what is going on about them. The periscope is a complex combination of telescope and camera obscura (see Camera). On the submarine, the periscope is a rustless steel tube, or perhaps bronze, usually about 30 feet long and 6 inches in diameter, except at the top, where it tapers to about 2 inches. The top is narrowed to reduce the tell-tale wake which betrays the presence of a diving boat.

At the top and bottom of the periscope are two reflecting 90° prisms, set parallel to each other at an angle of about 45° to the wall of the periscope. The scene before the top prism is reflected in it by horizontal light rays; the prism sends down the picture in vertical rays to the prism below; this converts the scene again to horizontal rays, which the observer sees when he looks through the eyepiece.

Between the two prisms are two telescopic systems in series, with the objectives, or large lenses of each telescope, facing each other. The upper telescope reduces the image, because the observer is looking through the large end of a telescope; but the lower telescope enlarges the image again, sometimes to six times the size of the original picture.

A "telemeter" scale, consisting merely of short lines set slightly off the vertical and horizontal centers of the field of vision, enables an observer to estimate the size and approximate distance away of any object in his field of vision. The observer's eyepiece usually is cemented to the lower prism, between two handles by which the periscope is turned. The field periscope, a smaller instrument, is used in trench warfare. (See Lens; Submarine; Telescope.)

PERRY, OLIVER HAZARD (1785–1819). "To windward or to leeward, they shall fight today." This was the grim determination which the venturesome young commander, Oliver Hazard Perry, announced on Sept. 10, 1813, when some of his officers begged him to refrain from battle with the British that day on account of the wind's direction. And with this decision he engaged in the bloody battle of Lake Erie, upon the issue of which rests his fame as one of the great naval heroes of the United States.

Several motives inspired Perry's determination. For one thing he had the family honor to sustain. His father had served with credit as a naval officer in the Revolutionary War, his three older brothers were then serving in the navy in the War of 1812, and his youngest brother was with him on board the Lawrence at the time of battle. He himself had entered the navy as a midshipman from his Rhode Island home in 1799, had served in the war against the Barbary pirates, and at his own request had been sent to serve on Lake Erie in the war.

Here at Presque Isle, near Erie, Pa., in the midst of a wilderness, he had undertaken with enthusiasm the arduous task of building and equipping a fleet, although men and materials had to be brought through trackless forests from the seaboard, 500 miles away. The work had been successfully completed and Perry had under his command nine small vessels which he was anxious to use. The fact that his commanding officer, Commodore Chauncey, had not given him the support and encouragement he needed was an additional reason for showing that he could win in spite of all difficulties.

The results of Perry's decision justified his expectations. His own vessel, the Lawrence, was so disabled that he had to leave it and row to the Niagara in a hail of bullets, but within two hours after leaving his ship he sent his famous message: "We have met the enemy and they are ours—two ships, two brigs, one schooner, and one sloop." For the first time in its long naval history, a British fleet had been compelled to surrender.

For this victory Perry was rewarded with the rank of captain and a vote of thanks by Congress. He was regarded by the people of the country as the naval hero of the war, and was popularly known as "Commodore" Perry. After peace was declared he was placed in command of a squadron in the West Indies, and there met his death a few years later from the dreaded yellow fever.

The Perry Memorial shaft at Put in Bay, Ohio, was dedicated in 1913. A tablet, commemorating the peace between America and Great Britain, was added in 1931.

The GREEK HERO who SLEW the MEDUSA

PER'SEUS. Once upon a time, so the old Greeks tell us, there was a king of Argos, old and none too good, whose name was Acrisius. Now this king had a beautiful daughter named Danaë, whom he feared,

because an oracle had told him that she would bear a son who would kill the old king. So built a Acrisius tower of brass, without a door, and here he shut up the maiden. And she was lonely. But one day a shower of gold fell through the window of the tower, and in the gold was Zeus the king of the gods. So Danaë was lonely no longer, and after a time she bore a son, and named him Perseus.

But when Acrisius heard of the child he was very angry, and he ordered that the child and its mother be set adrift on the sea in a chest. For days they drifted, but Zeus watched over them, and the chest was at last cast safely on the shores of an island, where a good fisherman named Dictys cared for them.

Here Perseus grew to be a young man, strong and blond and beauti-

ful. And he loved his mother dearly, for she was good as well as lovely. But one day Polydectes, the king of the country, saw Danaë, and loved her and wished to marry her. Danaë would not consent. Then Polydectes saw that if he would win the mother he must first be rid of the son. So he sent Perseus to fetch him the head of Medusa, thinking the lad would be killed.

This Medusa was one of three terrible sisters, called Gorgons, who had leathery wings, brazen claws, and, worst of all, writhing poisonous snakes

instead of hair. They were so horrible to see that anyone who looked at their faces was turned to stone. So naturally Polydectes thought he should never be troubled by the presence of Perseus again.

PERSEUS DENOUNCING POLYDECTES

When Perseus returned home and learned that his mother had been forced to flee to escape the violence of King Polydectes, he would have slain the king had not his mother thrown herself upon him and begged him to stop, for she feared that the people would avenge the king's death. Thereupon Perseus turned Polydectes and all his court into stone by showing them the head of Medusa. The island itself became stone, and the very frogs (so says the legend) became dumb.

But the boy was half a god and the old gods helped him. Athena, the goddess of wisdom, lent him her shield polished as brightly as a mirror; Hermes gave him a magic sword and a pair of winged sandals; and Pluto the cap of darkness which made him invisible.

With these things Perseus set out gaily, and after a long time he came to the land of eternal night, where the Graeae, the three Gray Sisters, sat shivering and They mumbling. were so old that they hated anything young and happy, and they had only one eye and one tooth among them. At first they refused to help Perseus, but the lad stole the eye as one sister was passing it to another, and wouldn't give it back till they had told him where he could find the Gorgons.

Then he set out again, and flew and flew till the wind whistled behind him. At last he saw far off the three Gorgons asleep. He put on his cap of darkness and flew nearer, till he hovered over them. Alighting, he held up the shining shield and looked into it, for a sight of the monster Medusa herself would turn anyone into stone. With a single sweep of the magic sword he then cut off Medusa's head. He hid the head in his wallet and fled. The other two Gorgons awoke, but the winged sandals bore him safely away, and he left them behind.

Presently Perseus came to the kingdom of Atlas, the Titan, and asked shelter. But Atlas answered him rudely, and Perseus grew angry and held up before his gaze Medusa's head, and so turned Atlas into the great mountain on which the skies rest.

After a time Perseus saw that he was flying above a country that had been devastated by earthquakes and by floods, so that the people lived in wretchedness. And as he flew, wondering, by the seacoast, he saw a beautiful maiden chained to a rock beside the sea. Quickly he flew down and saw that she was weeping. And Perseus said:

"Surely you are a king's daughter. Do they treat kings' daughters so in this strange land?"

Then the maiden answered and told him that her name was Andromeda, and that her father Cepheus was indeed king of the land. Her mother the queen, whose name was Cassiopeia, was very beautiful and very proud, and one day she had boasted that the sea nymphs were not more beautiful than her daugh-

ter. Then the nymphs were angry and complained to Poseidon, the sea-god, and he sent floods and earth-quakes and at last a great sea-monster to devastate the country. The monster could only be bought off by offering him the queen's daughter Andromeda as a victim. So now she was chained thus to the rock, awaiting death. It was small wonder that she wept.

But Perseus feared no monster, and when the great beast came he fell upon it with his magic sword and slew it. Then he cut the chains that bound Andromeda to the rock and bore her back to her rejoicing parents. And Cepheus gave Perseus his daughter's hand in marriage. But at the wedding feast an old suitor, who had made no effort to help her while she was in danger, claimed Andromeda, and Perseus had to turn him into stone also.

Then the hero with his bride set out for his island home, and arrived just in time to rescue his mother Danaë from King Polydectes, who was still troubling her. This king too the youth turned to stone with the convenient Gorgon's head. Then with his mother and his bride he returned to Argos, the land of his birth. Here he found that his grandfather Acrisius had gone to Larissa to watch the games there. So Perseus followed after, and took part in the games. As he was

throwing a quoit in one of the contests it accidentally struck his grandfather and killed the old man. Thus the prophecy was fulfilled, which foretold that Acrisius should be slain by Danaë's son.

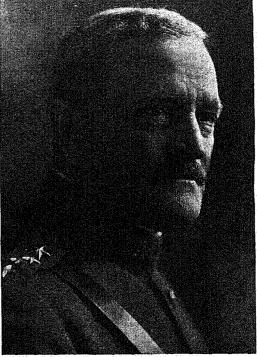
Perseus and Danaë and Andromeda lived long and happily in Perseus' kingdom, and the goddess Athena, to whom Perseus gave the Gorgon's head to fasten on her shield, befriended them always and made them wise. So that after his death Perseus was worshiped as a god, and Zeus his father took him into the sky, with Andromeda and Cassiopeia and Cepheus, where you may see them shining as bright constellations to this very day.

The name *Medusae* is given to a group of free-swimming jelly-fish, with many long tentacles, which give them a fancied resemblance to Medusa the Gorgon (see Jelly-Fish).

PERSHING, GEN. JOHN JOSEPH (born 1860). "Black Jack" Pershing became at the age of 57 the commander of the forces that turned the tide in the World War of 1914–1918. He was raised to the rank of general

of the United States Army, becoming the fourth commander in the history of the United States to hold this rank permanently. Only Grant, Sherman, and Sheridan had been full generals before him, for Washington had ranked only as lieutenant general of the United States Army, though he had been general of the Continental Army.

Pershing was born near Laclede, in Linn County, Mo., on Sept. 13, 1860. He was a descendant of Frederick Pershing (originally Friederick Pfoershing), of Alsace, who came to America in 1749. Although John J. Pershing, as a boy, was not a brilliant student, he was determined to get a good education. When he was about 17 he began to teach in a country school, and some time later, with the money he had saved, he entered the Normal School at Kirksville, Mo. While there he chanced



JOHN J. PERSHING

Commander in Chief of the American Expeditionary Force
in the World War of 1914-1918.

to see an announcement in a paper that changed his entire life. It was a notice of a competitive examination for West Point Military Academy. He did not then think of a military career; but he wanted an education and West Point offered an unusual opportunity. He won the examination by a single point.

Graduating from West Point in 1886, he at once began active service against the rebel Indians in the West. Five years later he received the appointment

as military instructor at the University of Nebraska. where he found the opportunity he had long wanted of studying law. He completed the full course and received the degree of Bachelor of Laws. From there he was called to West Point as an instructor in tactics, where he remained until the Spanish War in 1898, when he at once asked for active service. He was among the first 15,000 who sailed for Cuba, and two days later he was fighting in the battle of San Juan Hill. Afterwards General Baldwin said of him: "I have been in many fights in the Civil War, but Captain Pershing is the coolest man under fire I ever saw in my life."

On his return Pershing requested to be sent to the Philippine Islands which the United States had just purchased. His work there was the subjugation of the islands' savage tribes, the largest of which was the Moros, a people whom the Spaniards had never succeeded in conquering. In 1903 he was recalled, made a member of the General Staff Corps in the United States, and in 1905, when the Russo-Japanese War broke out, he was appointed military observer with the Japanese army, a position which gave him an opportunity to study modern warfare on a large scale.

He was now 45 years old and still a captain. Advancement in the army was too slow, Roosevelt thought, for an officer of his ability. He suggested promotion to Congress and finally, tired of the delay, with one flourish of the pen jumped Pershing over the heads of 862 officers of higher rank and made him a brigadier general.

In 1909 Pershing returned to the Philippines as governor of the Moro Province, where he remained until 1914, when he was recalled to pursue the Mexican bandit Villa. While thus engaged he experienced the greatest tragedy of his life. His wife and three little daughters were burned to death in a fire in San Francisco. His son alone was saved.

In the meantime war was raging across the ocean. Finally the United States was drawn into the struggle. Secretary of War Baker and President Wilson knew that in General Pershing they had the right man for the command.

It was a historic moment when General Pershing arrived at Boulogne. For the first time an American commander was to lead American troops on European soil. Tens of thousands of men, women, and children crowded the streets, waving the American flag and shouting, "Vive l'Amerique! Vive Pershing!"

Following Pershing came ship after ship of American soldiers. Given an absolutely free hand by President Wilson, Pershing had the heavy burden of shaping and training a whole army organization which ultimately expanded in a year and half to nearly 2,000,000 men. In this organization work he was wholly successful. His final test as a commander of men in the field was short, practically only the last few months of the war, but the record of those months when finally weighed will give General Pershing a high place as a commander.

General Pershing was retired in 1924. President Coolidge appointed him ex-officio head of the commission to supervise the plebiscite in the Tacna-Arica arbitration award. He arrived there in July 1925, but bad health compelled his return to the

United States in February 1926.

PERSIA-Land of Rugged DESERTS ISOLATED

PERSIA, or IRAN. Of the great Persian Empire that 25 centuries ago extended from the Indus to the Danube and from the Oxus to the Nile, only the western half of the Iranian plateau remains to modern Persia—a region about as large as

California, Arizona, New Mexico, and Texas. The ancient name Iran, by which the Persians have always called their country, became in 1935 its official name, replacing "Persia," which was derived from a small province Pars (now Fars). And its change in name may mark a new era for this old land, which is just beginning to emerge from centuries of backwardness that followed the decline of its ancient glory.

Today Persia, "the land of the Lion and Sun," is for the rest of the world simply a country out of which come beautiful things-Omar Khayyam's poems and countless legends and fables; "Persian" rugs, usually in exquisite flower patterns woven of silk or of fine

Extent.—North to south, about 860 miles; east to west, 1,385 miles. Area, about 628,000 square miles. Population estimated at about 15,000,000, including 3,000,000 nomads.

Physical Features.—Western half of Iranian Plateau (general altitude, 3,000 to 5,000 feet), crossed by numerous mountain ranges (Mt. Demavend, 19,400 feet); salt and sandy deserts cover about two-thirds of the plateau area. Salt lakes, Sistan and Urmia. Caspian Sea on north, Persian Gulf and Gulf of Oman on south; only navigable river, Karun.

Principal Products.—Wheat, barley, cotton, tobacco, rice, fruit, and nuts; silk, opium, gums; wool and hides; iron, copper, tin, lead, coal, petroleum, turquoise, salt, etc.; rugs and carpets; attar of roses. Chief Cities.—Teheran (capital, about 350,000), Tabriz (220,000), Meshed, Shiraz, Isfahan, Hamadan, Resht, Kermanshah, Kazvin, Kerman, Sultanabad, Abadan, Ahwaz, Babol, Mohammerah, and Yezd.

wool by hand, a knot at a time; attar of roses from the gardens of Shiraz; and turquoises from Nish-For the collector apur. it means old porcelains having a rare apple-green glaze, and manuscripts illuminated with delicate miniatures of turbaned

princes, flowering trees, and dancing gazelles, so faultless that there may be hundreds of figures in one square foot of battle scene, all of which will stand scrutiny with a magnifying glass.

Persia's Plateaus and Deserts

Persia has been sung by the poets as the land of luscious fruits, of roses and nightingales; and yet the Iranian plateau, which it shares with Afghanistan and Baluchistan to the east, is a high arid region more than two-thirds desert. It lies from 3,000 to 5,000 feet above sea level, with range after range of mountains traversing it from northwest to southeast, and rising to snowy heights of 10,000 to nearly 19,000 feet.

THEY'VE PLOWED THIS WAY FOR 2,000 YEARS



The peasants of Persia have been little influenced by Western civilization. This plow is the crotch of a hardwood tree, cut so that one end, sharpened and shod with iron, forms the plowshare, while the main trunk serves as the beam.

HOW PERSIANS MAKE BUTTER

To enter Persia is like climbing a ladder, whether you come across the Caspian Sea from Russia, or follow the old caravan trail from Trebizond, or sail up

the Tigris from the Persian Gulf, and take the older and steeper trail between Bagdad and Kermanshah. This is the way the English and Indian cottons and teas go, and sometimes it happens that a caravan falls into the hands of marauding Kurds and Lurs, who pounce upon it in the mountain fastnesses and exact a ransom for each camel.

In one-third of Persia nothing could ever be made to grow, no matter how you irrigated and tended the soil. The great salt deserts, or Kavirs, as the Persians call them, occupy the greater part of the eastern provinces. Across the salt deserts and the adjoining sandy deserts stretches a line of oasis towns like stepping stones-Meshed, the most hallowed spot for Mohammedans in Persia; then Tabbas; then Yezd, in the very heart of Persia, and important for its silk manufactures and opium trade; then Kerman. There is a prophecy that Yezd

will some day be overwhelmed by the desert sands that now drift over its walls and that have long since overwhelmed surrounding villages. At Kerman are manufactured some of the most beautiful Persian rugs. Forty miles west of Meshed, in a fertile plain, lies Nishapur, the birthplace of the poet Omar Khay-

yam. The town has fallen into decay, but turquoises are still mined near by.

It is in the western part of Persia that you will find most of the great cities and all that have been capitals in ancient and modern times. Here are Susa and Echatana, now Hamadan, the cities one reads of in Xenophon. Susa is the ancient "Shushan," where the story of the book of Esther is laid. Here, too, is Shiraz, the city of wine, rosewater, and attar of roses; and 35 miles east lie the ruins of Persepolis, the great city that Alexander destroyed in 330 B.c. These ruins are among the most important that have survived from the great ancient days of Persia. Ispahan, once a capital, lies at the center of the habitable part of Persia, in a pleasant well-cultivated plain. Tabriz is an important commercial center and the terminus of the railroad from Tiflis. The country's only other long railroad, the Trans-Iranian,

These women are using a goat skin for a churn. They shake it vigorously until the cream inside turns to butter.

passes through Teheran (native name Tehran), the capital. This city lies at the foot of the Elburz Mountains, 70 miles from the Caspian Sea, at an altitude

dry and bracing, and

you can see for al-

most unbelievable

distances. At night

the stars are so near

and clear that you

do not wonder the

early Persians were

star-gazers and as-

trologers, and that

"magi," their word

for priests, grew into

our word "magic."

beautiful gate of

tiles, and all the

better houses are

provided with little

parks and ponds,

and luxurious highvaulted under-

ground rooms for

the unbearable heat of summer; but the

total effect of the

city was long a dismal one, for most of

the houses were

colored

Teheran has a

porcelain

of 4,000 feet, overlooked by the snowy peak of Demavend, the highest mountain in Persia. The air is

DRESSED FOR THE STREET



In former days all Persian women, when they appeared in public, wore a veiled costume similar to this one. Today the veil is forbidden by the Today the veil is forbidden by the shah, and the women are discarding the stifling cloak for European garments.

built of grav mud and squatted along filthy narrow streets. At night, homes and streets were dark. Today the city presents a new face. Many of the one-story mud build-

ings have made way for tall modern structures, notably the postoffice, the Ministry of War building, and the Imperial Bank of Iran. The main streets have been widened, straightened, and paved, so that motor cars as well as the traditional camels and mules can carry the rugs, dried fruit, jewels, and grain that go to many parts of the world. Streets now glow with light each evening, for a central electrical plant has been installed. A central system of water supply is being developed, because the water has often run short in summer. Still a novelty are the trains that puff to and from the city on the new Trans-Iranian Railway.

Persian Shepherds and Farmers

About one-fourth of the people of Persia are city dwellers, and another fourth are nomads— Arabs, Turks, Kurds and Leks, Baluchis and gipsies, and Lurs.

These nomads pasture their flocks and herds in the grassy valleys and on the slopes of the mountain ranges of the interior of A MODEST HOUSE DRESS

Persia, and prey upon the peaceful communities for agricultural supplies. Throughout Khorasan you will see a queer sort of tower that the farmers build as a refuge from these marauders. It is a round mud wall about 14 feet high, inclosing an empty space and having its entrance so low that you can only get in on all fours.

Half the people are peasants, tillers of the soil, and this in spite of the fact that only three or four districts of Persia are naturally fertile. The most important agricultural province is Azerbaijan to the extreme northwest. This is the closed basin of Lake Urmia, a broad shallow sheet of intensely salt water, in the bed of treme northwest. This salt water, in the bed of



an ocean once ten times as large. The region is known to many Americans because of the American mission at the city of Urmia which met such sufferings at the

hands of the Kurds and Turks in the World War. There are also many isolated oases such as Shiraz and Ispahan.

In most places the Persian peasant can wrest crops from the soil only by irrigation, and irrigation is not the simple matter of canals and surface channels that it is in Mesopotamia or in the west of Armenia. Having little rain and few rivers, he must use the mountain snows as they melt, and must bring the water, often long distances, by tunnel—otherwise it would evaporate in the dry air and bright sun before reaching him. But for the mountains that store moisture in the form of snow, nine-tenths of Persia would be the desert that more than one-half is

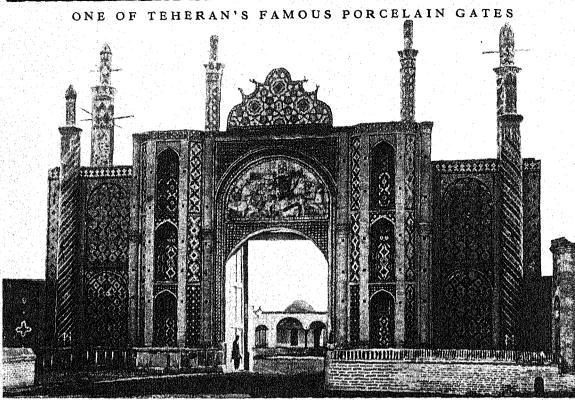
digs deep wells to water his land. Beneath this barren land lies buried the key to Persia's future-

now. Sometimes, too, the peasant

HE LIKES A COOL SMOKE



The Persian, like the Turk, usually smokes a "hooka," or "narghile," in which the smoke from the tobacco bowl first passes through perfumed water in that jar and then through that long tube to the smoker.



This is one of the twelve city gates from which the main streets lead to the great central bazaar or market-place of Teheran, where the products of native and foreign industry are mingled in hopeless confusion. Amid a babel of Persian, Turkish, Arabic, Hindu, Hebrew, and Armenian, the traveler can buy anything from an American-made hairpin to an antique rug.

oil. Vast petroleum fields stretch from the Caspian Sea to the Persian Gulf. The natives made no use of this rich fuel resource, but the oil fields are now being worked by foreign capital, and Persia stands high among the oil-producing nations of the world, with her largest and richest fields still untapped. Persian politics have been intimately associated with the international struggle for oil. Copper, iron, tin, lead, rock salt, and coal occur in large quantities, especially in the mountains of central and western Persia, but it remains for modern engineering to develop these great resources.

Always Haunted by Hunger

The peasants have been little affected by western civilization. After 2,000 years and more of successive conquests, they continue to till their soil just as Zoroaster and the Zend-Avesta told them to do several centuries before Alexander. They use the ancient plow, a crotch of a hardwood tree cut so that one branch may be sharpened and shod with iron for the plowshare, while the main trunk serves as the beam. They use the same flail, the same lumbering cart, the same yoke and ox-goad, the same hand-mill topped by a round hopper into which the grain to be ground is poured, and a glistening sickle so curved that it almost seems like a hook.

The crops are always small. In good seasons a man raises little more than enough for himself, and a crop

failure means starvation in that district. Hunger always lurks around the corner in Persia, and poverty is ever present.

Persia Adopts New Ways

Most of the people are Mohammedans of the Shiite sect, who have long been distinguished for their fanatical hostility to Christians and their opposition to foreign influence. But some of their prejudices were broken down under the progressive rule of Shah Reza Pahlavi, who held power from 1923 to 1941. Reza undertook many reforms designed to bring modern ways to a nation handicapped by disease, filth, and ignorance. He made education compulsory and freed women from the harem. He rebuilt part of Teheran and equipped it and other cities with electric lights, telephones, and radio communication. Roads which were once mere caravan tracks were surfaced, and the great Trans-Iranian railway linked the mud villages of the interior with the trade ports of Bandar Shahpur on the Persian Gulf and Bandar Shah on the Caspian Sea. near Russia. Motor trucks now speed past camel caravans, carrying tea, dates, wool, petroleum, and goods produced by the new mills and factories.

When Persia Began to Awaken

These are astonishing changes in a country which had so long resisted western influences. The first steps along the path of reform came early in the 20th century, inspired largely by young Persians educated in

THE FAMILY OF DARIUS AT THE FEET OF ALEXANDER



Darius III, king of the Persians, himself escaped, but his wife, his mother, his three children, his harem, and hundreds of his men fell prisoners to Alexander the Great at the great battle of Issus, in 333 B.C., in which the power of the Persians was broken. The chivalrous courtesy with which Alexander treated his royal prisoners was a favorite subject among later Greek writers.

Europe, who made Paris the center of their plotting. In 1906, 16,000 people of Teheran accomplished a revolution by means that would seem to us extraordinary. They simply took refuge in the mosques and other holy places and in the British compound and camped there until the Shah—up to that time an absolute monarch—agreed to grant them a constitution and an assembly with legislative powers.

Internal weakness and international jealousies, however, nipped Young Persia in the bud. By an Anglo-Russian agreement of 1907, Persia was divided into spheres of influence, the north falling to Russia and the south to England. This agreement prevented Persia from doing anything for itself and blocked the reforms of W. Morgan Shuster, an American, who was brought in, in 1911, to try to bring order into the country's finances. Successive assemblies were dissolved by force of arms.

The first World War and the downfall of the Russian Empire in 1917 threw Persia into great disorder. Reza Khan, a young officer in the Cossack division, then came to the forefront as a man of decision and determination. He rallied around him the disorganized soldiers, and in 1923, when the Shah, Ahmed Mirza, fled to Europe, Reza became premier. Ahmed Mirza was deposed and Reza was elected Shah in 1925. From the first he supported the work of Dr. Arthur C. Millspaugh, American financial adviser, who arrived in Persia in 1921 and did excellent work until political forces too strong for Reza to combat prevented the

renewal of Dr. Millspaugh's contract after 1927. Reza, however, afterward won Persia to a program of modernization.

Three Thousand Years of History

A thousand years before Christ, what is now Persia was in the hands of kindred agricultural and pastoral peoples-chiefly the Medes and Persians. Their speech was "Aryan" or Indo-European like our own, and their religious beliefs and practises are pictured in the Zend-Avesta of the great religious reformer Zoroaster (see Zoroaster). After a period of subjection to their Assyrian neighbors to the southwest, there came a brief-lived Median Empire (640-558 B.C.), followed by a Persian Empire founded by Cyrus the Great (558-528 B.C.), ruler of one of the small Persian tribes. In 20 years Cyrus had extended his rule almost from the borders of India on the east to the Aegean Sea on the west, and to Egypt on the south. He was a wise ruler, whose aim was to soften by kindness the harsh rule which his sword was constantly extending. He allowed the Jews to return to Palestine, whence they had been carried as captives to Babylon, and encouraged them to rebuild their temple. When he fell in battle against a nomad tribe in 528 he was laid to rest in a massive tomb that may still be seen near the city of Persepolis, the ancient Persian capital.

Cambyses, the son of Cyrus, added Egypt to the immense Persian Empire. To Darius the Great, who succeeded to the throne in 521, fell the task of organizing the Persian Empire. He divided the greater

part of his domains into 20 provinces, each ruled by a governor or "satrap," and each retaining a large measure of local freedom. He built roads from end to end of the empire and established a system of royal posts. By organizing a great Phoenician war fleet in the eastern Mediterranean, he made Persia the first great Asiatic sea power.

The decline of the Persian Empire begins with Darius' attempt to conquer the Greeks and extend his power to Europe (see Persian Wars). The great expedition of his son Xerxes in 480 B.C. suffered complete defeat at Salamis and Plataea. From then on the history of the Persian Empire becomes a fragmentary record of murders, palace intrigues, revolts, base betrayals, and disasters, culminating in the amazing

conquest by Alexander the Great.

Alexander broke the power of Persia in the battle of Issus, in 333 B.C. The entire Persian camp fell into the hands of the conqueror, and the Persian loss in killed and prisoners was enormous. Darius fled to Babylon, whence he sent an embassy to Alexander offering to divide his empire with him. But Alexander demanded unconditional submission, which Darius could not give. He spent two years raising a new army, estimated at 1,000,000 men, but was again defeated at Arbela, and soon afterward was murdered by his own traitorous followers. With his death the ancient line of Persian kings came to an end, and with it the Persian Empire.

About a century after the death of Alexander, Persia passed from the hands of his Macedonian successors into those of the Parthian kings. These were soon followed by native Sassanid rulers, of whom Chosroes II (590–628 A.D.) even threatened Constantinople. Mohammedanism won Persia religiously and politically soon afterwards, and Persian art and literature flourished under the Arabian califs. Firdausi, "the Homer of Persia" (940–1020 A.D.), the greatest poet of his country, sang in epic verse of Persia's early kings. Omar Khayyam (died about 1123), whose contributions to astronomy and mathematics were among the greatest achievements of his age, also left a collection of poems (the 'Rubai-

yat'), familiar to us in the splendid verse translation of Edward Fitzgerald. The tales of the 'Arabian Nights' also took shape on Persian soil. But the land became involved in the conquests of Genghis Khan and Tamerlane, of Turks and Mongols. Under the Sufi dynasty, of which Abbas the Great (1586-1628) was the most noted member, Persia's power and prosperity revived; and Nadir Shah (1736-1747) even invaded India. But the Kajar dynasty (1794–1925) was weak. Persia lost power and territory and became a pawn of European nations. In the first World War it was a battleground for the contending powers. In the second World War, Russian and British troops occupied its western borders to keep its oil and railways from falling into the hands of the Germans. Reza Shah Pahlavi, who had overthrown the Kajar Dynasty and had been elevated to the throne in 1925, was then forced to abdicate.

PERSIAN GULF. An arm of the Indian Ocean three times the size of Lake Superior thrusts up between Persia and Arabia to form the Persian Gulf. It has been an important body of water since ancient times. For Russia it is an outlet to the southern sea; for England it is a strong link in the route to India; Germany coveted its control as part of her scheme for world power; and the rich oil fields about its head are an additional cause of rivalry.

The Arabs called the gulf the Green Sea, from the color given it by great numbers of tiny sea animals. The Strait of Ormuz, 30 to 60 miles wide, connects it with the Gulf of Oman, which opens directly from that part of the Indian Ocean known as the Arabian Sea. The coast is flat and sandy on the Arabian side, high and steep on the Persian side. At the head of the gulf the waters of the Tigris and the Euphrates flow in after uniting to form the river called the Shattel-Arab. Since ancient times, the Persian Gulf has been noted for its pearl fisheries, which have made the name of the Bahrein Islands famous the world over. Today the Bahrein group is yielding even greater wealth from the oil discovered in 1932. is 520 miles long and from 150 to 200 miles wide, and has an average depth of about 200 feet.

HOW EUROPE was Saved from ASIATIC CONQUEST

The Effort of the Persians to Conquer Ancient Greece—The Story of Marathon and Salamis, Decisive Battles in the History of the World—The Heroic Tale of Thermopylae, where 300 Gallant Spartans Checked the Persian Hosts

PERSIAN WARS. One of the most momentous epochs in the world's history was the second decade of the 5th century B.C., when the vast Persian Empire, then at the height of its power, attempted to carry its conquests into Greece and thus extend Asiatic despotism to Europe. If the Persian kings had succeeded, the whole course of history might have been changed and the progress of civilization stayed for centuries. The fate of Europe lay in the hands of Greece, the little nation whose position

made it then, as it has at times been since, a buffer state between Europe and Asia.

The first Persian monarch to proceed against Greece was Darius I (521-485 B.C.), called "The Great" because of his colossal achievements in organizing and ruling the vast empire won by his predecessors. Among his subjects were the cities founded by Greek colonists in Asia Minor. Some of these cities, aided by Athens, revolted against Darius, capturing and burning Sardis, the Lydian capital.

At news of the catastrophe, Darius was transported with rage. "Who are these Athenians?" he demanded. When he was told, he made a vow to take vengeance upon them, and, according to the

story, he instructed one of his servants to remind him thrice each day: "Master, remember Athenians!" He gathered an immense army to send against the Athenians, but the expedition was wrecked in attempting to round the rocky promontory of Mt. Athos on the wild Macedonian coast (492 B.C.).

A second army was sent in 490 B.C. Arriving in safety, it drew up on the plain of Marathon, a short distance northeast of Athens. The Athenians were brave soldiers, but they were seized with terror and despair when they looked down from the hills and saw encamped on the plain this great army that had never known defeat, flanked by hundreds of vessels drawn up in the adjoining bay. Could they withstand so mighty an enemy?

Some encouragement was given by the arrival of 1,000 Greeks from the little city of Plataea who came to their aid. After

several days of waiting, the Athenian general Miltiades, believing that the contest must be decided now or never, gave the order to advance. Raising their war-cry, they rushed toward the Persians, who looked upon them as madmen thus to run into the jaws of death. But the invaders were soon undeceived. Miltiades had drawn up his men so as to

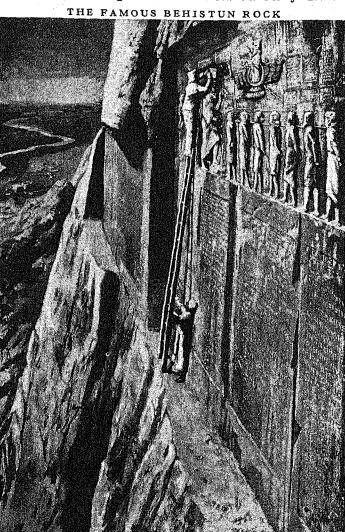
have the greatest strength in the wings. The Persians, as he had expected, succeeded in driving back his center, but the two wings closed in on either side and threw the enemy into confusion. Hemmed in

between the two lines of Greeks, the Persian bows were of no avail, while the stout Greek spears spread death and terror. Under the shock the Asiatics' line crumbled and they were driven in panic to their ships. Their loss was about 6,400 men, against only 192 on the side of the Greeks. Thus ended the epochal battle of Marathon—one of the decisive battles of the world-in which the Athenians for the first time averted Oriental domination. Still undismayed by this defeat, Darius began prep-

Still undismayed by this defeat, Darius began preparations for a third expedition, but before he had finished he had to turn his attention to an insurrection in Egypt. Next year he died, leaving the punishment of the presumptuous Greeks to his successor Xerxes.

The proud handsome Xerxes would gladly have spent his days in luxury, but when at last he decided to proceed against the Greeks, his preparations

were on a stupendous scale. To avoid such a shipwreck as had befallen his father's first expedition, he caused a canal to be cut through the isthmus of Mt. Athos—an undertaking requiring the labor of great numbers of men for three years. Then he caused a bridge of boats to be thrown across the Hellespont to connect Asia with Europe. This was destroyed



In the western part of Persia above the little village of Behistun, on a precipitous cliff towering 300 feet above the ancient highway, may still be seen this immense inscription—25 feet high and 50 feet wide—recording the triumphs of Darius the Great. To enable all his subject nations to read the inscription it was carred in three languages—Persian, Babylonian, and Susian—all in the curious cuneiform or wedge-shaped characters. Above the inscription is the figure of Darius himself, his foot upon the body of a usurper of the throne of Persia, whom he had overcome and slain. In 1835—more than 23 centuries after it was placed there—Sir Henry Rawlinson, an English officer and scholar, discovered the inscription. The perilous height was scaled and we paper impressions or "squeezos" were made. After several years of study Rawlinson deciphered it, thus rolling back the curtain of the past and giving the world the key to the lost language and history of ancient Babylonia and Assyria.



by violent storms; whereupon, it is said Xerxes ordered the Hellespont to be lashed with whips and

the engineers put to death.

Two new bridges of boats were built; and at last all was ready for the passage of the great host (480 B.C.). What a sight that must have been! The army included a motley of 46 different nations and tribes—nomad hordes of Asiatics, armed with daggers and lassos; Libyans, wearing on their heads the skins of horses' heads, on which the ears and mane were left to terrify beholders; Ethiopians, with their bodies painted half white and half red; men of all colors, dress, and arms, urged on by the lash of their officers. So enormous was the army, the historian Herodotus tells us, that seven nights were required for the crossing. Modern historians believe, however, that Xerxes' army could not have numbered much more than 200,000 men in all.

On his way toward Athens, Xerxes found a little force of Greek soldiers under the leadership of Leonidas, king of Sparta, stationed at the narrow pass of Thermopylae, which guarded the way from Thessaly to central Greece. Surely this handful of men would not dispute the way with his mighty forces, he thought. He sent a message summoning the Greeks to deliver up their arms. "Come and take them," replied

Leonidas defiantly.

The Persians, advancing to the attack under the lash of their officers, were held back for two days by the long spears and unbroken ranks of the Greeks, in spite of their superior numbers. Xerxes began to despair of forcing the pass, when a traitorous Greek told him of a roundabout path over the mountains. When Leonidas found that the enemy were approaching from the rear and that the end was at hand, he dismissed his men except the 300 Spartans, bound like himself to remain at their post and conquer or die.

Leonidas was one of the first to fall. Around the body of their leader the gallant Spartans fought desperately, defending themselves, as Herodotus tells us, first with their swords, then with their hands and teeth, until they were overwhelmed and slain to a man. Afterwards a marble lion was placed on the spot in honor of Leonidas (whose name means "the lion's son"). Another monument was erected to the memory of the Spartans and inscribed with these words:

Go, tell the Spartans, thou that passest by, That here obedient to their laws we lie.

The Final Defeat at Salamis

When Xerxes reached Athens, he found that the Athenians, following the advice of the great statesman Themistocles, had abandoned the city. Their ships, which had already suffered severely in an engagement off Artemisium, on the northern coast of the island of Euboea, were drawn up in the narrow strait between the island of Salamis and the southern coast of Attica. Xerxes set fire to the city, and while the flames reddened the sky took his seat on a marble throne upon a height overlooking the sea to watch the battle. He expected that his splendid fleet would win an easy

victory, but again and again he started up from his throne in rage, as one after another of the Persian vessels was sunk or crippled by the impetuous onslaught of the Greeks. Though his ships outnumbered the Greek vessels three to one, they were so heavy and so crowded in the narrow strait that they moved with difficulty and fell an easy prey to the lighter Greek ships, which followed the new tactics of rowing out from a circular formation and ramming their prows violently into the clumsy enemy vessels. Two hundred of the Persian ships were sunk, others were captured, and the rest turned and fled.

Leaving part of his forces in command of one of his generals, the terror-stricken Xerxes hastened back to Persia. A few months later the Persian army was scattered at Plataea. No Persian army ever again set foot in Greece. Europe was saved from Persian

conquest and domination.

PERSIMMON. In the Southern states there is no fruit more choice and luscious than the persimmon when maturity has taken away its harsh, puckery taste. Many people think that frost is required to remove the "pucker," which is caused by the presence of tannin. This is not true; the natural process of ripening causes changes which conceal the tannin flavor. Varieties which ripen before the frost have no pucker, and certain Japanese varieties never do have this disagreeable taste. They are known as sweet persimmons.

Because the Japanese persimmon (*Diospyros kaki*) is larger, prettier, and more suitable for shipping, it is the only kind of persimmon cultivated in this country. In Japan every garden has a persimmon tree. Our native persimmon (*Diospyros virginiana*) is

richer and of better flavor.

The tree grows as far north as Connecticut, but only in the south does it develop well. It is 20 to 30, even occasionally 60 feet high, with dark shining leaves and orange-colored fruit about the size of plums. The dense heavy wood is used to make shoe

lasts, shuttles, and heads for golf clubs.

PERSPECTIVE. As you look out along a railroad track, the rails, which you know are parallel, appear to meet at a point in the distance. The trees and telegraph poles appear to grow smaller as they recede farther and farther from your eye. If you were to draw this scene just as you see it, you would be making use of "perspective," which is the art of representing on a plane surface objects as they appear in space.

The ancient Egyptians and Assyrians knew nothing at all about perspective, as we can readily see from the drawings that have come down to us. The Greeks and Romans understood something of the art but it was forgotten or fell into disuse during the Middle Ages. This accounts for the queer flat appearance of the early Italian paintings. With the Italian Renaissance—especially the researches of the architect Brunelleschi and of that universal genius, Leonardo da Vinci—came the rediscovery and first real understanding of the principles of perspective.

The LAND of the INCAS and Its TREASURES

Great Storehouses of Natural Wealth in Peru that the Spaniards Missed and which Modern Enterprise is Developing

PERU'. The glamors of a storied past, of fabulous wealth, of scenery romantic beyond description, of mysterious and unexplored rivers and forests, of marvelous contrasts of climate and topography, still make Peru a name to thrill the adventurous, as in

the old days when Spanish conquistadores invaded the land in search of treasure.

This republic on the western coast of South America has been favored by nature with such a diversity of mineral wealth, soil, and climate that there is scarcely a product of any clime which it cannot produce in unsurpassed excellence. But geography as well as lack of capital has made production far from easy. The Andes extend through Peru in a massive wall, unbroken by low passes. Transportation between the interior and the coast is therefore a major problem, and many of the mineral and forest resources lie untouched. On the Pacific coast, where the chief money crops are grown, large areas await irrigation, for here the rainfall is insufficient for agriculture. But development of the country is progressing. Great enterprises, such as the oil industry, have been set on foot by foreign capital.

The acreage of irrigated land is being extended. Means of transportation are gradually improving.

The traveler who has pictured the coast of Peru as covered with tropical vegetation like that of the Atlantic side of South America is astonished to find here an arid, dreary, treeless coast strip, 20 to 30

miles wide, save for a few green river valleys at wide intervals. Rain rarely falls in this region, for the towering summits of the Andes intercept the moisture-laden trade winds from the southeast and the precipitation is all on the eastern slopes.

For a large part of the year, however, the coast is bathed by heavy mists, caused by the cold Antarctic or Humboldt current which sweeps up from the south. As is the case all along the Pacific coast of the American continent, good harbors are few.

Towering above this narrow coast strip, which is the seat of some of the largest towns, are three ranges of the Andes mountains, interposing a formidable barrier between the coastal zone and the vast forest region drained by the Amazon. Peru thus falls naturally into three zones: the coast zone; the "sierra," or great table-land lying in the valleys between the three ranges of the Andes; and the "montaña," or river and forest zone, on the eastern slopes. The coast zone comprises about one-tenth of the total area. The sierra occupies about a fourth part, and the forest zone the rest. Boundary disputes with its neighbor Ecua-



"Chunchos" is merely the Spanish name for the natives of the eastern "montana" or forest zone of Peru.

dor make the area of Peru uncertain. But it is officially estimated at about 485,000 square miles, excluding the Ecuador territory which it claims (see Ecuador). The coast line is about 1,400 miles long and the country's average width is 800 miles. An enormous river system breaks through the eastern chain

THE STRIP BETWEEN SEA AND MOUNTAINS



This is one of the two important railway lines of Peru; it runs from the coast by way of Arequipa to Lake Titicaca and to Cuzco, chief city of the Incas. The other railroad runs from Lima eastward into the Andes. Both of these lines cross the barren coast strip, which looks as if it could support no life of any kind, but they also tap the rich mineral resources of the mountains.

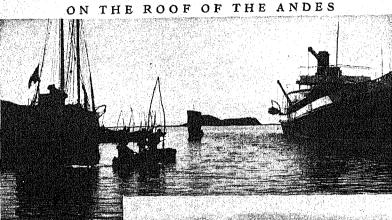
of the Andes and flows through impenetrable jungles to form the Amazon. Of these rivers the greatest is the Marañon, generally taken to be the true source of the Amazon.

The three divisions of Peru differ so widely in climate, products, and population that they form in

various levels from 5,000 to 12,000 feet. Through the entire length of the sierra region are immense grazing lands, on which cattle and sheep are raised, as well as alpacas, and the most useful of all the Andean animals, the llamas. The wools of these animals and of the vicuña, which lives wild at great heights, are

used for clothing and are also exported in considerable quantities. (See Alpaca; Llama.)

On the temperate eastern slopes of the Andes and in the tropical river valleys are vast tracts of territory, for the most part undeveloped, on which abundant harvests of almost every known crop could be raised in a remarkably short time. "It is sufficient to cut down and burn the brush and scratch the soil and sow with any seed, to recover returns of



Lake Titicaca, more than 12,500 feet above sea level, is the highest body of water in the world traversed by steamships.

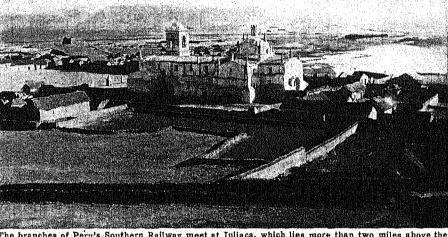
effect worlds to themselves, and the inhabitants of one find it difficult to adapt themselves to conditions in the others. Difficulties of communication isolate one region from another. Many of the upland cities are accessible only by airplane or mule trails.

The vast, thinly settled forest region has no routes of travel except those furnished by its many rivers.

What More Water Would Do for Peru

The coast towns, with the valleys of the few rivers that flow into the Pacific, are the center of the commercial, intellectual, and political life of Peru. In the narrow valleys of the coastal rivers the land when irrigated is wonderfully fertile. In this region cotton and sugar (Peru's chief export crops) and rice and tropical fruits are grown, though only a small fraction of the arable land is under irrigation.

The plateaus and valleys of the sierra, with their more bracing climate, contain a great extent of fertile soil, but much of it can be cultivated only by terracing the steep hillsides as did the ancient Incas. Coffee, corn, wheat, barley, potatoes (which came originally from this part of South America), alfalfa, coca (a shrub from whose leaves cocaine is extracted) flourish at



The branches of Peru's Southern Railway meet at Juliaca, which lies more than two miles above the sea in the Andes, west of Lake Titicaca. The weather here is so cold that only barley and potatoes can be grown. Trade in cattle, wool, and hides is the town's chief means of support.

a hundred for one," says one authority. Most of the products of the tropics—sugar cane, cacao (the source of chocolate), cotton, and coffee—are here cultivated, but the difficulty of transportation greatly retards development. The forests of valuable woods in this region cover more than half of the area of Peru. The rubber forests appear inexhaustible but are difficult of access; and the rubber trade has left an indelible stain on the country because of the unspeakable cruelties inflicted on the native workers in the Putumayo region. Another famous product is quinine, made from the cinchona tree, which used to be known as "Peruvian bark."

The mountains contain extensive deposits of copper, silver, lead, gold, vanadium, coal, zinc, sulphur, and other minerals. The production of petroleum, which is found near the seashore, exceeds in value that of all other natural deposits.

ONE OF THE OLDEST CITIES IN THE NEW WORLD



The palms waving in the breeze remind us that Lima is really in the tropics. It is about as far south of the Equator as Jamaica is north. Rain is all but unknown here, but the atmosphere is very moist, and in winter dense fogs prevail. This little beauty spot in the heart of the city is one of those typical squares or "plazas" which show the Spanish influence. This one is called Plaza Colon, which means Columbus Square, and the monument is a memorial to the great discoverer.

THE MODERN PORT OF AN ANCIENT CITY



Callac, chief port of Peru, is one of the most important Pacific ports of South America, and one of the few harbors where passengers and cargo can be unloaded direct from ship to wharf. This air view shows the modern construction of the wharves. Large passenger and freight vessels from North America and Europe make it a regular port of call; those from the Atlantic come through the Panama Canal. Callao faces Peru's naval base on San Lorenzo Island, and is the home port of the Peruvian navy. The city, of about 75,000 population, is only 20 minutes from Lima by auto; and it is also connected with the capital by steam and electric railroads. It is the seat of many industries and business establishments, and is frequently called "down-town Lima."

Med and and

To open up these enormous agricultural and mineral resources, transportation is the chief thing needful. It now takes a journey of 17 days by rail, mule-trail, and water to go from the capital Lima, near the coast, to Iquitos, near the source of the

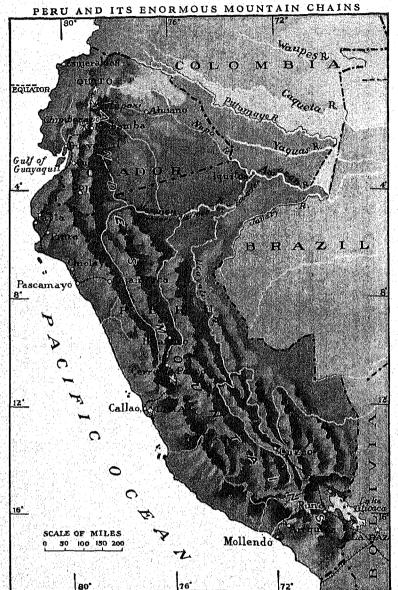
Cotton and sugar rank first among the manufactures of Peru, which are not extensive. High speed mills of the latest type, which are replacing the old machinery in the sugar factories, are greatly increasing production. The cocaine from Peru

largely supplies the world's de-Lima, the capital and mand. largest city, manufactures cotton and woolen textiles, sugar, cocaine. and tobacco (see Lima, Peru). Arequipa, the second city, has cotton and flour mills, chocolate factories, and leather manufactures. The chief ports are Callao, six miles west of Lima, and Mollendo in the south. Callao, the gateway to Lima, has one of the best-equipped harbors in South America. Cuzco was the chief city of the Incas, who obtained gold from the mines and stream gravels in the region. Cerro de Pasco. northeast of Lima at an elevation of more than 14,000 feet, is one of the highest and greatest mining camps in the world. Gold and silver are mined in conjunction with copper mining, the chief industry of the district today.

The population is officially estimated at about 7,000,000. About half are pure Indians. A third are mestizos, of mixed white and Indian blood, and less than a sixth are whites.

Peru contains many interesting remains of ancient Indian civilization (see Incas). Buildings of immense size, and beautiful pottery and implements testify to the high degree of development attained. From its conquest by Pizarro in the 16th century (see Pizarro, Francisco), until its erection as an independent republic in 1821, Spain's rule over Peru was most barbarous. In 1824 a liberating army from Colombia under Gen. Simon Bolivar finally rid Peru of Spanish rule. Disorders followed and it was not until 1844 that a stable

government was erected. With but two exceptions there was peace in Peru from that date until 1879, when it became involved in a war with Chile (see Chile). Peru was defeated and lost the province of Tarapacá, also possession of Tacna and Arica for a period of ten years, when a popular vote was to decide which country should have permanent control. However, for a variety of reasons, the vote was never taken and the



Peru's boundaries with her northern neighbors have long been in dispute. The boundary with Colombia was settled recently by an agreement which gave Peru all the territory south of the Putumayo River.

Amazon—a distance of 1,224 miles, or less than that from New York to Omaha. Peru's short railways total some 3,000 miles. The 4,000 miles of navigable waterways, and pack-trains of mules and llamas have furnished the only other transport, but 12,000 miles of motor highways are now open, and air travel is increasing. Between Peru and Bolivia on Lake Titicaca, steamers navigate at the greatest height in the world.

situation became serious. In 1929 an agreement was reached. Chile kept Arica and the Arica-Tacna Railroad. Peru received Tacna, with port rights in Arica.

According to the constitution, the president, the senate, and the chamber of deputies are all chosen by the vote of literate males over 21 years of age. Power is strongly centralized in the hands of the president. Catholicism is the state religion. Elementary education is compulsory, but about three-fourths of the people are illiterate.

PETER, SAINT. "Follow me, and I will make you fishers of men," said Jesus to the two sturdy fishermen, Simon, called Peter, and Andrew his brother; and without hesitation they rose, pulled their nets

into the ship, climbed over the side, and went with him. They knew him, having seen him in the crowd that gathered to listen to the great preacher, John the Baptist.

Peter became the most prominent of the Twelve Disciples, and in the meager accounts given in the New Testament of the lives of these men who went about with Jesus preaching and doing good, Peter's name is most often mentioned. With James and John he formed a little intimate group around Jesus, and with them was present at some of the great incidents of Jesus' lifethe transfiguration on the Mount, and the last night before his crucifixion.

It was St. Peter, according to the gospels of

St. Matthew and St. Luke, who first gave voice to belief in the divinity of Jesus—"Thou art Christ, the son of the living God." Peter was generous-hearted but impulsive; and he it was who, when men came to arrest Jesus, lifted his sword, although he was only one against a crowd, and smote wildly at the man nearest him, cutting off his ear. Yet only a few hours afterward, when Jesus had been led off to the house of the high priest, Peter denied that he ever had known him. Later he bitterly repented his denial, and ne was the first of the Apostles to whom Christ appeared after his resurrection. At a later meeting Jesus gave him the command: "Feed my lambs."

Peter, thus assured that the Master still trusted him, grew daring and courageous, and became the great teacher in the early days of the church, preaching throughout Palestine, performing miracles of healing, and enduring great hardships and persecution. That he worked in Rome for a time is accepted by Catholics and many leading Protestant scholars. Roman Catholics count him as the first bishop of Rome and the first pope. His claim to the position of head of the church is based also on the words of Jesus to Peter: "Thou art Peter, and upon this rock (Greek "petros," meaning either "rock" or "Peter") will I build my church." After many years, according to tradition, the Romans took him prisoner in the reign of Nero and crucified him. Peter, impetuous as of old, declared he was not worthy to be crucified as was his Master, and asked to be crucified head

downward, a request which the Romans readily granted.

The First Epistle of Peter was written by him; but the evidence as to the Second Epistle is not so clear. It is believed that the Gospel of Mark is derived from Peter's accounts of the life of the Master.

PETER THE GREAT (1672-1725). Russia has two faces: one is turned toward Asia, with the other it looks out on Europe. Its western face has never lost the features given it by the greatest of the Romanof family, Peter the Great.

In Europeanizing Russia, Peter owed something to his predecessors, who had made contracts with the western world and permitted traders and colonists to come into Muscovy, as Russia was

Muscovy, as Russia was called, and to settle in the outskirts of Moscowitself. It was to these colonists and to his French tutor that the boy Peter, neglected at court, turned to learn in the reigns of his older half-brother and sister.

In 1689 the ruthless boy of 17, a man in energy and decision, shut up in a convent the half-sister who had been acting as regent, and disregarded the feeble-minded half-brother who was supposed to be joint ruler with him. It seemed nothing short of insanity for a ruler to attempt to beat down the walls of tradition, custom, culture, religion, and geography that shut Russia off from the Europe of Louis XIV's day. But Peter did it almost single-handed. Brutal, barbaric, without scruple, without even a memory of kindness or conscience or morals, he whipped Russia into a place in the circle of European powers.



PETER THE GREAT

The Creator of the Greater Russian Empire

A CZAR WHO BELIEVED IN DEFYING CONVENTIONS



When Peter the Great visited England in 1697 he leased Sayes Court, the estate of John Evelyn at Deptford, which was near the shippards Peter wished to study. Peter did much damage to Evelyn's gardens, which were among the most famous in England, and made it one of his chief amusements, so it is said, to ride in a wheelbarrow through a thick holly hedge which had been Evelyn's special delight. What did the Czar of all the Russias care about a garden?

Nothing could stop this volcano of human energy, and he stopped at nothing to reach his ends. He was as if driven by an inner fire and his activity was unceasing. He reformed the army, began the navy, crushed the church into subjection, introduced new taxes, forced European ways and dress on his reluctant nobles, furthered the introduction of western education, products, and processes, and sent abroad Russians to learn, while he brought in western Europeans to teach. Drunk or sober, he spared neither himself nor his people.

Peter not only drove but he led. He tried to learn everything himself, whether it was shipbuilding or tooth-pulling. He longed especially for a direct view of a civilization that would rouse his land from its isolation and Asiatic seclusion. So in 1697 he visited Europe, ostensibly as a subordinate member of a group of Russians who were to learn western ways; but it was Peter who did the learning. Prussia, Hanover, and Holland were visited, and in the latter country the czar himself worked in a shipyard. Three months were spent in England, and several hundred English engineers and artisans were added to the party. When the Russian party left, the English cleaned out the residences assigned them much as they would clean a pig-pen. Louis XIV avoided such a visitation by insisting that, as Peter was traveling incognito, he could not give him a royal reception. Peter therefore traveled on to Vienna; whence he was recalled by a plot of the royal guard (Streltsi) aided by the Old Russian party. After crushing the rising, Peter divorced his wife, who was thought to be in the plot.

The Founding of St. Petersburg

In 1703 he founded a new capital at St. Petersburg (later Petrograd and now Leningrad), near the Baltic at the mouth of the Neva, which he had won from the Swedes (see Leningrad). On a later visit to Europe, in 1716–17, all the reactionary forces in Russia rallied behind Peter's son, Alexis. The revolt was in vain, and the son died in prison from tortures.

In his external policy Peter determined to secure for Russia ice-free outlets to the sea, which he called "windows toward Europe." His first blow fell on Turkey in an effort to secure a foothold on the Black Sea. In 1696 he captured Azof, at the mouth of the

river Don, only to lose it 15 years later.

In the meantime he had challenged Sweden, the greatest military power of the north, which in that day controlled the eastern end of the Baltic, Russia's other possible outlet. From 1700 to 1721 it was a duel between Peter the Great and Charles XII of Sweden. Peter's raw recruits were beaten at first, but they learned and Peter learned; and Charles was even more rash and impetuous than Peter and would not learn. At the battle of Poltava (1709), in southern Russia, Peter won a decisive victory. The war continued, each leader drawing to his support the other's enemies. Peter triumphed in the end, and by the peace of Nystad, in 1721, Russia became

a Baltic power, with a shore line on the south of the Gulf of Finland. A year later a war with Persia gave him a foothold on the Caspian Sea.

In 1712 he had married his mistress, and on his death in 1725, he made her his successor as Catherine I. Probably no ruler has ever left a greater impress on the land over which he ruled than did this czar, half brutal barbarian and half benevolent despot.

PETREL. "Mother Carey's chickens," as the petrels are called by sailors, wander over the oceans of the whole world. They live entirely on the sea, coming to shore only for a brief nesting season. Following every ship, weathering every gale, these strongwinged little birds are the pets of all seamen.

The name petrel means "little Peter," and it was given to the birds because their habit of "walking on the water" recalls the biblical story of the apostle Peter. The birds, however, always do their "wavewalking" upheld on spread wings, and the feat can scarcely be called walking, in the strictest sense.

Strange stories and superstitions are connected with the petrel. They are supposed by many to be under the protection of the Virgin Mary, and each bird is believed to represent the soul of a sailor lost at sea. Seamen believe that their appearance presages a storm; hence comes the name of a common species,

the storm-petrel.

Petrels vary in size from the storm-petrel, 5½ inches in length, to the forked-tailed petrel, 9 inches long. The general color is brown or grayish-black; some species have a patch of white feathers at the base of the tail. Generally but one egg is laid, in a rocky crevice or in a burrow in some bank. The birds feed on small water animals or any refuse cast overboard from ships.

Petrels belong to the order of tube-nosed swimmers (*Procellariiformes*). They are grouped in two families, the *Procellariidae*, which includes the fulmars and shear-waters, and the *Hydrobatidae*. Scientific name of storm-petrel, *Hydrobates pelagicus*; of fork-tailed

petrel. Oceanodroma furcata.

PETROGRAD, RUSSIA. When Peter the Great founded his new capital in 1703, he named it St. Petersburg. During the World War the Russians disliked the German sound of that name, and changed it to Petrograd; then they renamed it Leningrad in 1924, in honor of Nikolai Lenin. (See Leningrad.)

PETRIFIED FORESTS. Over vast areas of the western United States and elsewhere are forests that have been turned to stone. In some instances the growing trees were buried by great showers of volcanic ash. Water, carrying silica and other minerals, trickled through the overlying stratum, and the plant tissues were replaced by these minerals. So complete was this exchange that the microscopic structure of the trees is perfectly preserved. In time, erosion partially uncovered these forests. Many of the trees, stripped of bark and branches, are scattered over the ground, but a few petrified trunks stand where they grew. (See Fossils; National Parks and National Monuments.)

The "ROCK OIL" that Turns a BILLION WHEELS

New Type Derricks and Rigs on the Outskirts of Oklahoma City

PETROLEUM. In Mexico, the land of "gushers," a well of oil spouting suddenly from the earth shot higher than the top of the Washington Monument and drenched the country for two miles around. The first blast of gas and oil wrecked the derrick and hurled the two-ton drill bit 125 feet away. Thus the world's greatest oil well, the Cerro Azul No. 4, was brought into prodigious production in February 1916. This giant just south of Tampico shot up more than 260,000 barrels of oil the first day it was closed in.

Almost as spectacular in its way has been the rise in 80 years of the petroleum products business. From a small beginning it has grown to an enormous industry which now both lubricates and turns the wheels of our automobiles, trucks, motorcycles, farm tractors, warships, steamships, submarines, motor launches, and airplanes. Several billion dollars have been invested in the industry in the United States. For every dollar invested in steel there is more than industry, and recently the proportion

invested in steel there is more than \$2 in the oil industry, and recently the proportion in favor of oil has been increasing. Approximately 500 commercial products are derived from crude oil, and new uses are constantly found for it. Oil has become so essen-



The great Cerro Azul gusher in Mexico spouting oil at the rate of 100,000 barrels a day.

tial in modern life that nations bargain for oil fields, and even peace or war may hinge upon an oil treaty.

Petroleum, once called "rock oil," is not a new discovery. In Russia the flaming wells and springs of Baku, holy city of everlasting fire, have flared for hundreds of years. In many parts of the world oil has poured from the ground, or been found in wells, or as a seum on ponds and lakes. The Assyrians, Egyptians, Greeks, and Romans made some use of it for lighting, in manufacturing cements, and in embalming the dead. North American Indians anointed their bodies with it, or took it internally as medicine. The usually resourceful American colonists, however, regarded it only as a nuisance when they found it while drilling for salt, and they let it run to waste or merely bottled it as a nostrum.

In 1826 a Dr. Hildreth said that "this product offers great resources as an illuminating agent and will certainly become of great utility in

lighting the future villages of Ohio." Here and there a shop or mill adopted it for lighting, but the odor and smoke of crude oil made the first efforts to market it a complete failure, and petroleum remained undeveloped until the discovery of coal oil.

Kerosene, or "coal oil," distilled from coal, began to displace whale oil in the 1840's. Experimenters soon found a similar illuminant could be obtained by refining petroleum. The result was a demand for more petroleum than could be obtained from brine wells and from skimming pond surfaces, so a company was organized to bore for oil in Venango County, Pa. A well driven on Oil Creek by Edwin L. Drake in 1859 struck oil at $69\frac{1}{2}$ feet.

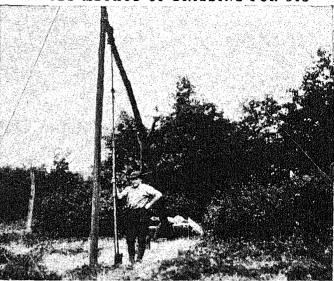
Colonel Drake's discovery started the first and greatest of many "oil booms," which have made millionaires by the score. It also marked the beginning of the petroleum industry. About 1870 the Standard Oil Company was organized. This company soon became the most important factor in the oil industry in the United States (see Rockefeller, John D.).

What is this wonderful substance that has become so vastly important? Crude petroleum is a mixture, in varying proportions, of many complex hydrocarbons, with small amounts of sulphur and other impuri-

ties. It is one of the bitumens, groups of substances which may be gaseous, liquid, or solid (natural gas, petroleum, asphalt, and mineral wax or ozokerite), but are all of a similar chemical nature. It varies in color from almost white through amber and greenish brown to black. Its consistency ranges from a fluidity like that of naphtha or gasoline to a heavy viscosity like that of tar or pitch.

Science is not certain how petroleum was formed. Most geologists, however, believe both petroleum and natural gas have been made by the age-long decomposition of organic matter confined under high pres-

AN OLD METHOD OF DRILLING FOR OIL



Drilling a well by the old "spring-pole" method. The weight of the bit and the rods attached to it are counterbalanced by a load of stones at the end of the sweep, or walking beam, so that the driller can move the drill "string" up and down with the least effort.

sure between layers of impervious rock. The resulting fluid oils probably were drawn by capillary attraction into the reservoirs where they are now found, rather than having been produced there in the first place. Because oil is nearly everywhere associated with salt water it is believed that it was formed from beds that were deposited in the sea.

Whatever its origin, petroleum is found in sedimentary rock of practically all geological formations except the earliest and the latest; large deposits are found in Paleozoic, Mesozoic, and Tertiary beds (see Geology). Oil is often found permeating porous

sandstones, with natural gas above and salt water below. It is sometimes sealed in "pools" by domes of impervious rock, and often subject to pressure which produces a "gusher" when first tapped. Such pools are of definitely limited extent. The gushers of Mexico often show no sign of failing until without warning they begin to spout hot salt water instead of oil. The famous Tepetate-Casiano pool of Mexico, which produced more than 75,000,000 barrels of oil in eight years, is about half a mile wide and three miles long. The oil region of Pennsylvania has been more thoroughly drilled than any other field, yet less than one per cent became producing territory.

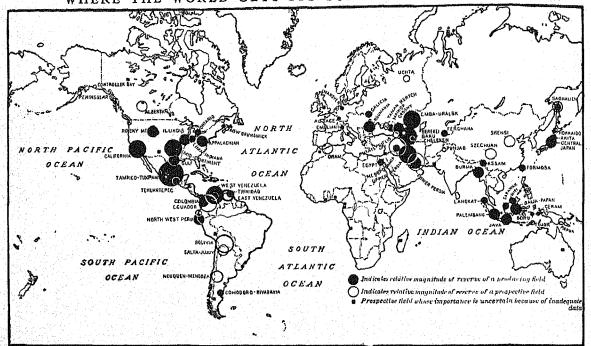
Oil is found at many levels. The early wells at Baku on the coast of the Caspian Sea were scooped out by hand to a depth of not more than

ON THE ROAD TO MANDALAY-AND TO WEALTH



Oil lands in Burma are so rich, and the oil so close to the surface that crude methods like this often bring in rich wells. Here, natives working for a few cents a day laboriously dig the wells by hand, and the débris is pulled to the surface in jars on a rope hauled by women over a crude pulley arrangement.

WHERE THE WORLD GETS ITS SUPPLY OF PETROLEUM



As the size of the black circles is determined by the relative importance of the various producing fields, you can see that the world's greatest known oil reserves are in the United States, Mexico, the northern part of South America, Russia, Persia, the Dutch East Indies, Rumania, and Burma. These are now supplying more than 90 per cent of the world's production. Other producing areas of less importance are in Canada, Peru, Argentina, Ecuador, France, Germany, Poland, Iraq, Egypt, and Japan. Oil has been found in many other regions where development is only on a small scale or has not yet been started.

50 feet. After Drake hit oil at $69\frac{1}{2}$ feet, the Pennsylvania wells produced it in the "third sand" at depths between 400 and 500 feet. Today wells often go down 6,000, 8,000, 10,000 feet, or even farther. Some wells in Baku, side by side, vary in depth by hundreds of feet. Oils from the same field, but of different geological formations, may differ widely in composition.

At one time 19 wells out of every 20 drilled failed to strike oil in paying quantities; now one in four produces paying oil. Science has brought about this higher average by the use of geology in prospecting. Geological study serves not to find the actual oil, but to discover the formations of the earth that are likely to contain oil. Knowing the conditions in which oil is usually found, the geologist uses his knowledge to ascertain what lies beneath the surface of a given area. The expense of digging down to find the oil is not undertaken until he discovers conditions that are favorable. Photographs made from airplanes are sometimes used to select likely regions for prospecting. The radio and the seismograph also are used: the seismograph, by recording the progress of an explosive shock through the ground, indicates to the scientist the formation of the ground beneath (see Mines and Mining).

There are still "wildcatters" who sink test wells without the aid of geology. In the rare cases in which such ventures strike oil the rewards are tremendous, because the price of leaseholds soars when a locality

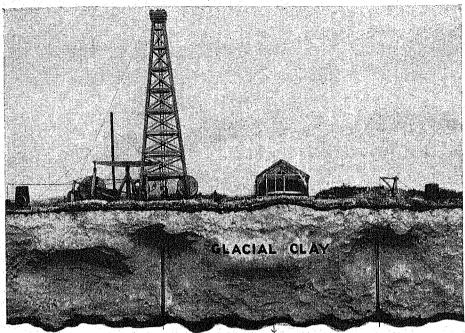
appears to hold oil. Leases are arranged usually on a royalty basis, the land owner getting perhaps one-eighth of the value of any oil found on his property, with the remainder going to the promoters who finance the drilling. In regions rich with oil the royalty may be one-sixth, with sometimes an additional bonus for the land owner.

The first oil wells were drilled with a primitive spring-pole, at the end of which was a weighted tool. Men pulled down the pole to raise the tool, then released the pole to drop the weight to the ground. A similar but advanced device is still used to start a well, but instead of the spring-pole, pulled by human muscles, towering derricks carry the weights to the top on pulleys moved by electric motors or by oil or gas engines.

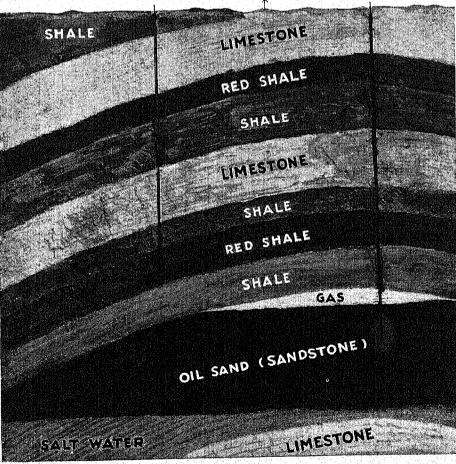
A modern oil field bristles with steel or wooden derricks, called "rigs." These are from 80 to 120 feet high, with a base about 20 feet square. The two common methods of drilling are the old standard and the rotary hydraulic systems. The nature of the ground determines which is used; sometimes both are employed on one well at different levels.

In the standard system, a "string of tools" is raised and dropped by a walking beam, counterbalanced in the rig. At the bottom of the string of tools is a bit which pounds into the earth and rock. It is fitted into a drill stem, which is attached to drilling "jars," or sliding links which in turn are hooked to a rope socket. Each string may be 20 feet long at the

AN OIL WELL IN MINIATURE



1440 FT. OF ROCK OMITTED



YOU can see just how an oil well works by looking at the miniature oil well in the Field Museum of Natural History, Chicago, shown at the left.

The model has two shafts going down through the rock lay-ers. The shaft at the right is completed. It has reached the oil in the porous Kirkwood oil sand at the bottom, a cavity has been made at the foot of the shaft by "shooting" with ni-troglycerin, and the oil is being pumped out by the small triangular pump jack at the top of the shaft. These pump jacks are commonly used in Illinois and some other states instead of derricks. This model shows a well in the Lawrenceville oil field of Illinois.

The power to run this pump jack and others not shown comes from the power house in the center. In it is a horizontal wheel, 18 feet wide, and an eccentric which operates rods running to the jacks.

The shaft at the left represents a new well being drilled. Above it is a derrick operating a simple churn drill. A steam engine drives a large walking beam, from one end of which the heavy steel drill and drill rod is suspended. The motion of the beam causes the drill to churn up and down in the well. In the derrick are tools to clean the shaft and pipes for casing it.

Notice how the layers of rock have an upward bend, or "anticline," which forms an inverted basin in which the oil has been caught. It is held there by the upward pressure of the salt water on which it floats. The hard shale above it will not let it escape.

beginning, but as the well gets deeper, new jars are added to produce a sharp shock on the upstroke for loosening the drill. The wells are lined progressively with casings of iron pipe to keep them from collapsing.

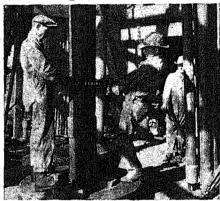
In rotary drilling there is a heavy circular steel platform turning on the floor of the derrick, with a rectangular slot in the middle through which tools are lowered. As the table rotates, a string of tools acts as an auger. A heavy perforated "fishtail bit," at the end of a drill pipe, rasps through the rock, while water forced down the pipe flows back between the pipe and the wall of the well, carrying out mud and strengthening the wall. The drill often curves instead of going straight down, because of obstructions or the nature of the ground. At 6,000 feet down, a California well was found to be 517 feet off the well's mouth. Thus one well might easily get its oil from a neighbor's land.

Oil is found in what are known as "sands," of differing thicknesses and at different depths. Wells often produce oil at a shallow depth, and later more oil is found at second, third, or even fourth sands. When oil sand is reached, the result is like releasing an artesian well. Gas pressure, held back under the rock for long ages, shoots up the oil with terrific force. Such a phenomenon is called a gusher. Drill tools are then withdrawn and the well closed with a valve at the top. Another valve at the side permits the oil to flow to receiving tanks or temporary pits. If the gas pressure fails, pumping or other methods are used to force up the oil. If a well does not flow naturally or freely, it is "shot"that is, long canisters of nitroglycerin are exploded in the well to crack the rocks and allow the oil and gas to flow to the bottom of the bore. Some wells that seem exhausted are made to produce by shooting.

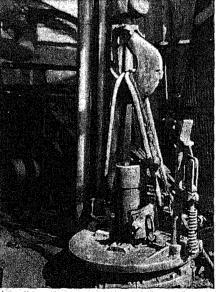
DRILLING THOUSANDS OF FEET



These men are raising the drill bit, a giant chisel attached to a long sectional rod which is turned in the boring by means of the circular rotary table through which the rod passes.



Sections of pipe are screwed together to line the well as it is drilled. Here a length of casing is being threaded into place. At the right are sections of the drill rod with threaded ends.



A section of casing has been lowered into place and drilling is about to begin again. At the left can be seen the long chisel-like drill bit, and to the right the gearing to rotate the drill.

Wells that appear dead may sometimes be revived by flooding the old sands with water, by tunneling under them, or by the "gas lift" or "air lift." By these lifts compressed air or dry gas is pumped to the bottom of the well, and mixes with the oil; being lighter than the oil itself the mixture rises. If gas is used gasoline is recovered from it.

Sometimes the spouting oil and gas take fire, producing a flaming geyser of oil. Millions of dollars worth of oil and gas have been wasted in such blazes. The causes are often mysterious. Sometimes when a well is tapped, underground rocks are carried up with the spurting oil, and a rock striking a steel casing causes flying sparks to ignite the oil and gas. When that happens it is only a matter of seconds before a mountain of fire is shooting to the skies. Such a fire in a California field blazed for more than eight weeks. It was finally snuffed out as one snuffs out a candle. A five-ton cap of steel like an inverted funnel was dropped over the burning well by tractors, and confined the flame to a chimney. Turning a valve on the cap then plugged the chimney and smothered the fire. At the same time another valve released pressure below the flame to keep the cap from being blown off. Before the capping, pressure had been reduced by tunneling to the main casing and piercing it. Other great fires have been subdued by scattering the blaze with an explosive. Asbestos-clad workmen then beat out the small fires.

Nature of Crude Oil

The article on Chemistry tells how atoms of carbon and hydrogen may be linked into hydrocarbons. These differ in such properties as inflammability, oiliness, or waxiness. The various petroleums are largely mixtures of such hydrocarbons.

Paraffin-base crudes consist largely of saturated, or paraffin,

hydrocarbons. The four simplest are the inflammable gases methane, with one carbon atom, ethane with two carbon atoms, propane with three, and butane with four.

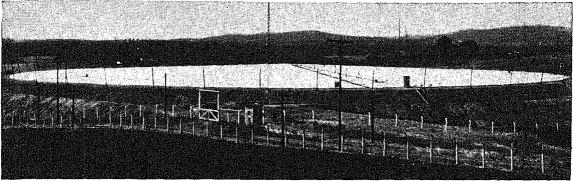
The hydrocarbons of the group from *pentane*, with five carbon atoms, to *decane*, with ten, are highly volatile, inflammable liquids. Gasoline is a mixture of these. The next five heavier hydrocarbons form kero-

It was sold as heating fuel, or even dumped on rivers to get rid of it, until laws forbade this because of the fire risk created. Invention of the automobile not only created a market for gasoline, but by 1915 brought the petroleum industry to a crisis.

A Crisis Met by the "Cracking" Process

In this year, the sale of gasoline exceeded that of kerosene for the first time, and fractional distillation

A MILLION BARRELS OF OIL AWAITING TRANSPORTATION



This 1,000,000-barrel underground reservoir near Santa Fe Springs, Calif., is roofed over with wood, and covered with asbestos paper to guard against fire. Steel towers and grounded wires act as a further safeguard against the danger of lightning.

sene. Still heavier ones produce fuel oil and lubricants; while the heaviest appear in mineral waxes, such as paraffin, and mineral jellies such as petrolatum or vaseline. Paraffin-base crudes are the richest of all petroleums in gasoline, lubricants, and wax byproducts.

Asphalt-base crudes are rich in unsaturated naphthene hydrocarbons, which have two atoms of hydrogen for every one of carbon. The chief products are fuel and illuminating oils, lubricants, and artificial asphalts. Mixed-base oils contain both paraffin-base and asphalt-base materials.

Refining by Fractional Distillation

Early petroleum refining used "step-by-step" heating, or fractional distillation, to boil off or vaporize the various groups or "fractions" of hydrocarbons. A temperature of 400° F. boiled off the crude naphtha or gasoline fraction. Of this fraction, the light naphthas are used chiefly in laboratory work and as light solvents. Gasoline is principally intermediate naphtha; heavy naphthas, or benzines, are used as paint or rubber solvents, and for dry-cleaning.

Heating the crude oil to 475° F. drove off the kerosene. Higher temperatures with mechanical treatment separated the "gas oil" fraction of light heating and Diesel oils, the heavy heating oils, and the lubricants, waxes, and asphalt substitutes. At 700° F. all residue turned into petroleum coke. Under this process a typical American Mid-Continent crude might yield 4 per cent gases, 25 per cent gasolines and naphthas, 15 per cent kerosene, 40 per cent gas oil, 12 per cent paraffin wax and lubricants, and 4 per cent coke.

These proportions were satisfactory, so long as kerosene was the most valuable product. In those days gasoline was largely a nuisance, of little market value. could not be made to yield more gasoline without requiring the production of ruinous quantities of other products as well. Without new refining processes, the limit seemed to have been reached.

But in 1912 a "cracking still" devised by Dr. W. M. Burton and others had proved able to break down, or "crack," heavier hydrocarbons into gasoline. With some improvements, this process enabled refiners to avert the threatened gasoline famine. They could "skim" or "top" crude oil for straight-run gasoline and kerosene, then crack the gas-oil fraction for more gasoline. Today petroleum is made to yield from 43 to 45 per cent of gasoline, perhaps 6 per cent kerosene, some 3 per cent lubricants, and 46 to 48 per cent fuel oils and other products. About half the gasoline is obtained by cracking.

Hydrogenation of Coal

Meanwhile Europe faced an opposite problem. Most European nations must import their petroleum, and wanted a cheap substitute; so European inventors worked to build up hydrocarbons that would yield gasoline by forcing hydrogen and carbon from inexpensive sources to unite. Soon after the World War of 1914-1918, Dr. Friedrich Bergius of Heidelberg, Germany, did this with his hydrogenation method. Coal broken into small bits was mixed with oil, iron oxide, alumina, and titanium. This mixture, together with water gas containing hydrogen, was intensely heated and compressed until it yielded a tarry substance from which oil could be extracted with benzene. The metals in the mixture removed impurities and helped by catalysis (see Chemistry) to unite carbon and hydrogen. "Synthetic" gasoline refined from this oil cost much more than the American product, but not more than Europeans were paying. Germany adopted the process and relies on it for much of its motor fuel supply. In the United States, hydrogenation is used to turn heavy hydrocarbons into lubricants.

Another important new process is polymerization, which forces together the molecules of light gases to form heavier useful hydrocarbons. A catalytic process, developed by Eugene J. Houdry of France, is applied to crude oil, increasing both the gasoline yield and the octane rating.

Refining of separate batches by fractional distilla-

tion now is largely replaced by continuous quantity-production methods, using heat exchangers and pipe stills. The exchangers transfer heat from products which have been treated, to the incoming supply; when intense heat and pressure are needed, as for cracking, they are supplied by running the "stock" through the coils of a pipe still. Heated crude oil and vapors come continuously from the exchangers and stills to fractionating or "bubble" towers, such as the one shown in the accompanying picture. After separation, the fuel fractions are washed with sulphuric acid, alkali, and water to dissolve out impurities. Heavier fractions often are separated in vacuum stills, where partial vacuums lower the boiling temperatures sufficiently to permit vaporization of the heavy hydrocarbons. Vapor-phase refining heats the entire crude to vapor before further processing.

Fuels can now be made almost exactly to suit requirements. Gasoline sold under the old "gravity test" might have had from two-thirds to three-fourths the specific gravity of water. The lighter grades were rich in light hydrocarbons, that vaporized easily in cold motors; the heavier grades gave more power while running. Now the United States government's fuel specifications require that

exact percentages shall evaporate within certain temperature limits. These limits are fixed for each grade—motor fuel, aviation gasoline, and other grades. The old "flash point" test, or temperature at which a fuel gave off just enough vapor for a momentary flash when a flame was passed over it, is useful chiefly for kerosene. Most states require a flash point of at least 110° F. for safety.

The Octane Anti-Knock Test

In the older automobile engines the gasoline vapor in the cylinders was compressed to one-fourth its volume before being ignited (see Automobile). Higher compressions would give more power, but could not be used, because the vapor exploded too soon and kicked back or "knocked." In 1922 Thomas Midgely, Jr., and

T. A. Boyd found that adding a little tetraethyl lead and some ethylene bromide to gasoline permitted several times the usual compression without knocking. Treated, or "ethyl," gasoline was first sold in 1923.

In 1930 engineers adopted the "octane number" test for rating the anti-knock quality of fuels. Two test hydrocarbons are used. One, heptane, knocks violently. The other, iso-octane, can scarcely be made to knock at all. The fuel to be tested is used in an adjustable engine until it begins to knock. Then a

mixture of heptane and iso-octane is found which matches the fuel in knocking. The percentage of iso-octane in the mixture is called the octane number of the fuel. The higher the octane number, the more compression the fuel will stand without knocking.

Refiners soon learned to improve the octane-number ratings of ordinary gasoline. In 1933 they arranged with the patent owners to use ethyl in ordinary grades, provided these were kept about 5 octane numbers below ethyl grades. Benzol, which has high antiknock properties, is also used in gasoline.

These modern fuels make possible compression ratios of over 6 to 1 in automobiles. Aviation fuels, up to 100 octane-number rating, used in high-compression engines, enable modern airplanes to fly with heavy pay loads at what once was racing speed.

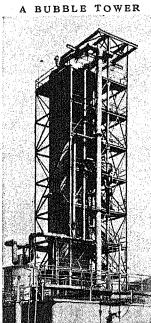
Refiners now make considerable use of "casinghead" or "natural" gasoline. This is gasoline vapor carried from wells by natural gas, called "wet" gas in contrast to vaporless "dry" gas. It is recovered either by compressing the gas, or by absorption in various materials. It is rich in highly volatile elements, and is used to improve ordinary gasoline.

The heavy fractions used for lubricants are freed from wax and asphalt

by freezing, by mechanical separation in presses or centrifuges, by filtration, or by use of solvents. Propane, liquefied at 40° F. below zero, is used in such refining to freeze out wax; or it may be used with sulphuric acid as a solvent for impurities. Butane, propane, and pentane are extensively marketed in liquid form as "bottled gases."

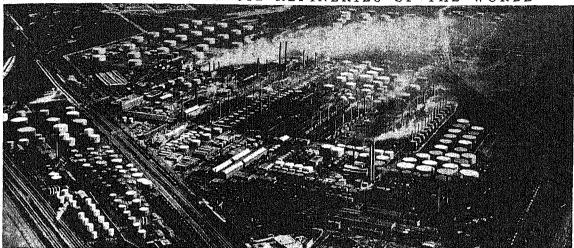


Next in importance to gasoline are the heavier fuel oils. For every gallon of gasoline, slightly less than one gallon of fuel oil is produced. It is burned instead of coal in many steamships, steam locomotives, heating furnaces, factories, oil refineries, and gas and electric power plants. The lighter grades are burned in household furnaces and cookstoves; the heavier,



Though the detailed operation of fractionating or bubble towers is extremely complex, the essential principle is simple. Heated vapors are introduced and rise through a series of perforated trays. Heavier substances condense on the lower trays; lighter ones bubble through this condensed material to higher levels. Thus each group or fraction of material, such as the gasoline, kerosene, and light-oil fractions, condenses at a definite level, from which it can be drawn off as a continuous side stream, as long as vapors and heat are supplied.

ONE OF THE GREAT OIL REFINERIES OF THE WORLD



Here at Whiting, Ind., the ground is dotted with hundreds of storage tanks which contain oil and the many different grades of fuel made from petroleum. An intricate system of pipe lines connects the various stills and tanks. This bird's eye view gives the reader an idea of the enormous amount of equipment that is necessary to feed our millions of automobiles with fuel.

in ships. Diesel engines use fuel oil to form the explosive mixtures that drive them, in much the same way as an ordinary automobile engine uses gasoline (see Gas Engine).

By-Products of Petroleum Refining

During the processes of distilling and cracking, petroleum may be made to yield innumerable by-products. These are so different and have so many uses that it is hard to realize they all come from this one source. From the lighter portions of petroleum, for example, are derived substances used in making plastics, synthetic rubber, antifreeze solutions, solvents for lacquer and paints, and compounds like toluene for making explosives (see Plastics; Rubber; Explosives).

From the heavy distillates come most of our modern lubricating oils as well as the mineral wax called paraffin (see Lubricants; Paraffin). Medicinal oils, salves, creams, ointments, and flotation oils for recovering metals from ores are made also from the heavy distillates.

Even the solid residues yield very important byproducts. Among these are lubricating greases, medicinal preparations, road oil, and asphalt (see Asphalt). Another product, petroleum coke, is consumed as fuel and is used also to make carbon electrodes and carbon brushes.

New industrial uses for the by-products of petroleum are continually being discovered, and for chemists petroleum itself is an inexhaustible mine of raw materials from which new synthetic compounds can be created (see Chemistry).

Transportation in the Oil Industry

Many oil-producing regions are remote from centers of population, and the characteristic way of transporting the oil to refineries is through pipe lines. Some of these are very long. The pipe line from Kirkuk in Iraq carries oil 1,165 miles across burning deserts to its terminals on the Mediterranean Sea. In Russia,

pipe-line systems of comparable length carry oil from the shores of the Caspian Sea to industrial centers to the west and north. The United States has a network of some 130,000 miles of pipe lines, and among them are found individual lines which measure from 1,000 to about 1,400 miles. These link the producing regions of the South and West with the refineries of the Middle West and the East. The original Standard Oil Company owed its power largely to control of pipe lines, but these are now common carriers, available to any producer.

From the refineries a system of pipe lines on a much smaller scale carries gasoline and other products to important distributing and consuming centers.

Pipe lines usually are made of steel, and they range from 4 to 24 inches in diameter. Pumps at intervals of 40 to 200 miles force oil through them at about 4 miles an hour. Reserve supplies are held on tank "farms" until needed. Different batches of oil or gasoline can be sent through the lines one behind the other without mixing with each other. To keep the lines from clogging, they are regularly bored out with a rotating circular scraper called a go-devil. It is forced through the pipe by the flow of the oil.

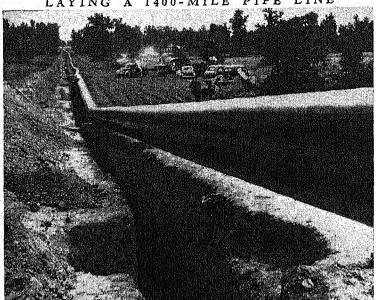
Supplementing the pipe lines are railway tank cars and motor trucks. The tank cars carry some of the crude oil to refineries. The motor trucks usually carry gasoline and other products from the refineries and bulk stations to service stations, garages, and other retail outlets.

Oil is carried across the seas in large ships called tankers. A huge fleet is employed both in world trade and to carry oil from California, Texas, and Louisiana to refineries on the Atlantic coast. Tankers make up some 15 per cent of the world's total ship tonnage.

American and World Production of Petroleum

The world production of petroleum varies greatly from year to year, as demand changes in response to

LAYING A 1400-MILE PIPE LINE



Here is the way a pipe line is treated to make it last 100 years or more. Above, we see it fresh from a cleaning and a prime coat of tar. At the right, a special machine, moving 30 feet a minute, gives the pipe another coat of tar and wraps it with asbestos felt to prepare it for its long stay underground. The line shown here is the famous Big Inch, 24 inches in diameter and 1,400 miles long. It runs from Longview, Tex., to Phoenixville, Pa., where it branches to Marcus Hook, Pa., and to Bayway, N. J.

business conditions and also as old fields become less productive and new ones are developed. The lowest world output in the peacetime years between 1918 and 1939 was about 1 billion, 310 million barrels of 42 gallons each in 1932; but more than 2 billion barrels were produced in other years.

Of the total output, the United States supplies from 60 to 63 per cent. Soviet Russia is second, usually supplying somewhat more than 10 per cent. Venezuela is third, with about 9 per cent. Persia, the Netherlands Indies, Rumania, and Mexico come next; each of them usually supplies between 2 and 4 per cent of the

world total. Iraq, Colombia, Argentina, Trinidad, and Peru contribute something like 1 per cent apiece. Many other producing regions exist, but do not contribute important amounts to the world supply. Canada gets a small part of its supplies from Alberta and Ontario.

Within the United States, Texas normally produces more than one-third of the domestic supply. California supplies about one-sixth, Oklahoma between oneseventh and one-ninth, and Illinois and Louisiana a tenth or less. Other important producers are Kansas, New Mexico, Wyoming, Arkansas, Pennsylvania, and Michigan. Together they furnish about one-seventh of the supply. Small amounts come from Montana, Kentucky, Indiana, Mississippi, New York, West Virginia, Ohio, and Colorado. The Appalachian fields produce chiefly paraffin-base oils; the California and Gulf Coast fields, chiefly asphalt-base crudes. The other states yield mixed-base crudes.

Conservation Measures

The steady increase in motor and airplane traffic, in the use of Diesel power and oil heating, and in demand for petroleum by-products brings ever greater demand for petroleum. But most fields cease to give freely flowing oil within a few years. Therefore the world faces the double task of constantly finding new fields and

avoiding as much waste as possible in its use of oil.

The most obvious methods of conserving oil are enforcement of measures to insure maximum yield from each field and limiting production to the amount immediately needed. But in the United States the law gives ownership of petroleum to anyone who brings it to the surface of his own land. Thus a landowner may drain petroleum from beneath his neighbors' lands. In the past, owners protected themselves by drilling wells and extracting oil as rapidly as possible. This made intelligent conservation almost an impossibility. A further provision of the law created added

the law created added trouble by forbidding control through price agreements. In 1924 the United States government created a Federal Oil Conservation Board to recommend measures for avoiding waste. Later several oil-producing states took control of production within their borders and threatened to close down wells, or even closed them, during periods of overproduction and ruinously low prices. Both states and individual producers also practise proration by agreeing not to exceed output quotas which are based upon past production. In 1935 Congress approved a pact among several states to



enforce conservation measures and also passed the Connally bill, which forbade interstate transportation of "hot" oil—that is, oil produced in violation of state laws.

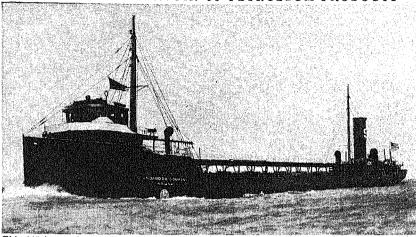
Problems Caused by War

In 1939 the outbreak of war in Europe transformed the world's petroleum problems. The Axis powers did not have adequate supplies within their borders, and their enemies strove to keep them cut off from outside supplies. They countered by developing synthetic oils, and they shaped their strategy to seize oil fields (see World War, Second).

The United States was able to supply the immensely increased quantities needed by Great Britain and for its own defense activities by letting operators produce more, at some risk of depleting future supplies. Grave problems arose, however, in transportation and refining.

The Atlantic and Pacific coasts normally get a large part of their supply of crude oil and gasoline by water transport. But British losses of tankers led the United States government to divert scores of these vessels to supplying the British Isles and this cut down the number available to serve the American coasts. After the United States entered the war, many of the tank-

A FLOATING RESERVOIR OF PETROLEUM PRODUCTS



This 465-foot tanker carries petroleum products from the refineries of northern Indiana to various distributing points on the shores of the Great Lakes. It can carry 2,250,000 gallons—enough to fill 225 railway tank cars. Some ocean tankers carry up to 5,000,000 gallons.

ers in the coastal reserve were sunk by German submarines. At the same time, the military and naval needs for petroleum multiplied. To meet this situation, gasoline for civilian use was rationed, supplies were shipped by tank cars, trucks, and inland waterway barges, and new pipe lines were built.

Refiners faced sharp increases in demand for such products as aviation gasoline, toluene for explosives, and materials used in making synthetic rubber. So new plants were built and more efficient processes were developed to produce these substances in greater quantities from the petroleum available. (See also Petroleum in FACT-INDEX at the end of this volume.)

HOW to BE GOOD to YOUR PETS

PETS AND THEIR CARE. A well-cared-for pet is a source of constant pleasure to one who loves animals. Gentleness and kindness are the two means of winning the love and confidence of any pet, and there is a heart-satisfying happiness which

comes from feeling that some dependent creature looks upon you as the kindest being in the whole world.

But only too often pets suffer cruelly through the negligence of even loving masters. The following rules should be followed strictly in caring for any pet: (1) it should be fed regularly; (2) its living quarters should be kept clean and sanitary; (3) it should have

constant access to fresh water; (4) with the exception of cats and dogs, pets should be handled only when necessary or after they have gained enough confidence to invite caresses; (5) the habits of the pet

should be studied and it should be given its natural surroundings as nearly as possible and its individual tastes not whims should be studied and gratified. There are at least 50 different kinds of animals and birds that are more or less commonly used as pets. Of these we have space for the discussion of only a few.

Dogs.—To understand the dog of whatever breed, we should know something of the habits of its wolflike wild ancestors. Like the wolves, dogs run down their prey by following scent, and sometimes hunt in packs. Their powers of smelling are keen far beyond any of the senses of human beings.

Each breed has its own peculiarities, but in general the dog should be cared for as follows:

If he sleeps in the stable or some part of the house, see that his bed is kept dry and clean and free from fleas. Straw often changed, or a piece

of carpet frequently washed, will do for a bed. He should be taught that this particular spot is the one place he is to sleep. If a kennel is used, it should be

well ventilated and built so that it can be cleaned and aired when not in use. The walls should be whitewashed or painted with creolin.

The dog should always have access to plenty of fresh clean water. Most dogs are overfed. meals a day, a light breakfast and supper, are enough. The diet should be varied. Meat, cooked, may be given in small quantities; cooked vegetables should be given at least twice a week. For breakfast give porridge with milk, and a dog biscuit three or four times a week if necessary. The food does not need to be warm, and should not be hot or sloppy. For the evening meal, give a mixture of vegetables and cooked meat, one-fourth or less of meat to threefourths of bread or vegetables. The dog should have bones to gnaw, but never the bones of game or chicken. The drinking dish should be washed every day. The dog should never be fed at the table or at any but regular hours.

The dog has a very sensitive skin and should be washed only when necessary. The water for the bath should be tepid and the head wet first; no water should be allowed to get into the ears. For constipation give olive oil or small doses of castor oil; for wounds apply flowers of sulphur and crude petroleum mixed to the consistency of thick cream.



Cats. — Puss has been a household pet for so many centuries that we do not know about her wild ancestors. She has been of the

greatest use in ridding houses of rats and mice. In Dick Whittington's time a cat was worth its weight in gold. The cat should have a special sleeping place in a box or basket, with a soft bed which should be changed or cleaned often. If she is confined to the house, a shallow tin of dry earth or ashes should also be kept for her use and emptied daily.

Cats should be fed at regular periods. Meat is their natural food and should form the greater part of their diet, with liver and fish as occasional variations. Most authorities agree that grown cats should never have bread, potatoes, or any other starchy food, and strongly advise against the feeding of milk. Water should be kept for them in a clean dish.

Short-haired cats do not need to be bathed, but those with long hair need frequent baths. To keep the cat free from fleas wet the fur in a mixture of two tablespoons of creolin in one quart of water, or a lather of tar soap or special flea soap.

"Kitty, Stop Eyeing that Bird!"

Train kittens when they are young to be neat in their habits and to leave birds alone. They should be punished every time they notice a bird. Cats should not be allowed out of doors at night, for they do the most harm to birds in the early morning.

Goats.—The goat is one of the most useful animals in the world. Its ancestors lived in high mountains; therefore it is a successful climber and has learned to forage upon anything it can find. There are many



famous breeds of milch goats; the Angoras and Cashmeres have been bred for their fine fleece. The pet goat should have a warm light stable for winter, with plenty of dry bedding; and the place should be cleaned often. The goat must have plenty of fresh air and exercise to keep healthy. Its winter food should be corn fodder, cowpeas, clover hay, or alfalfa, with oats, corn, and bran. It likes plenty of salt and must all the time have access to fresh water. If housed in winter, it should be given twigs of hazel or maple to browse upon for entertainment. The goat should never be teased. An Angora should be washed twice a month during the summer.



Rabbits and Hares. — The name rabbit is applied to both the hares and rabbits in America (see Hares and Rabbits). But besides their physical differences the two are unlike in their habits; the rabbit is a burrowing animal, while the hare

lives in a "form," a nest on the surface of the ground where the grass is beaten down or eaten out to afford a space of convenient size. Several well-marked breeds of rabbits have been developed in Europe and Asia, such as the lop-eared, Angora, Himalayan, Dutch, silvertip, Flemish, Polish, Japanese, and Belgian. The common cotton-tail rabbit is a true rabbit, while the various jack-rabbits are hares.

The Shelter from Rain and Wind

Pet rabbits should be kept in boxes or hutches so built as to protect them from rain and cold. The hutch should be well ventilated and easily cleaned. A hutch for one rabbit should be at least three feet long and a foot and a half wide and high. The ends must be draft proof and the floor raised above the ground. A sleeping apartment should be partitioned off at one end; the hutch should be bedded down with sawdust and the sleeping apartment furnished with clean fresh straw or hay. If possible, the rabbit should have an outdoor run made of fine-meshed wire netting set at least two feet down into the ground to prevent him from burrowing out.

Rabbits and hares are vegetarians. Their chief food should be hay, clover, oats, and bran; and green food, such as grass, clover, cabbage, and roots, especially carrots. The oats, bran, or meal should be dampened but not sloppy. Food should be given in vessels that have edges turned inward so that it cannot be scratched out. These pans must be kept clean. Water should be given in a vessel fastened to avoid spilling.

When handling a rabbit do not lift it by the ears alone; clasp the ears firmly with one hand and support the animal's weight with the other.

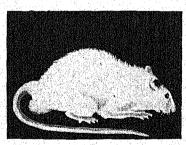


Guinea-Pigs or Cavies.—These animals came from South America, where there are many species, varying in size from that of a mouse to a halfgrown pig. The breeds used for pets

are the English, with a smooth coat; the Abyssinian, with a rough coat arranged in cowlicks or rosettes; the Angora, with smooth, soft, long hair; and the Peruvian, with long hair in rosettes. All these varieties may have one or several colors.

You Must Shelter Those Guinea-Pigs, Too

The guinea-pig should be kept in a hutch inside of a house or shed, for it cannot endure cold. An inverted box a foot square with a six-inch hole in the side makes a good nest for one guinea-pig when filled with straw or hay. These animals live exclusively on vegetable food—fresh grass, lettuce, celery leaves, beet tops, plantain, water-cress, dandelions, and parsley, with apples now and then. A constant supply of carrots insures good health. Whole or rolled oats may be given, and plenty of fresh water must be supplied. Several females and one male live together happily, but if several males are kept together they are likely to fight each other. The long-haired varieties need to have their coats brushed often.



White Rats and Mice and Fancy Mice.—
In general the treatment of all these should be the same, except that rats must have a larger cage. A box with a lid and one side cov-

ered with wire screen, with a floor area of 12 by 24 for a pair of rats, and 12 by 6 for a pair of mice, will do. The box may have a slit at the bottom along one side which may be opened to clean the cage with a scraper. A movable nest-box with a lid and a hole in one side may be attached to one side of the cage or put in a corner on the floor. The cage and

nest-boxes should be cleaned each week with soap and hot water and thoroughly dried before being used again. The bedding may be sawdust or layers of paper; the nest-box should have paper in fine strips or excelsior.

Rats are fed meal-worms, hard-boiled eggs, table scraps, and carrots. Mice eat canary seeds, white millet, oats, stale bread or dog biscuit soaked in skimmilk, apples, carrots, grass heads, and dandelion leaves. Neither rats nor mice should be fed sugar, salt, or cheese. They are very thirsty animals and must be provided with fresh water at all times or they may kill each other.

Dancing mice should be provided with a playhouse in the cage. This is made by taking a wooden box, without a cover, about three inches square and two inches high. Cut holes one and a half inches wide down the sides of the box opposite each other. Invert this box in the middle of the cage, and the little creatures will run in and out through the openings for hours, until they are almost exhausted.



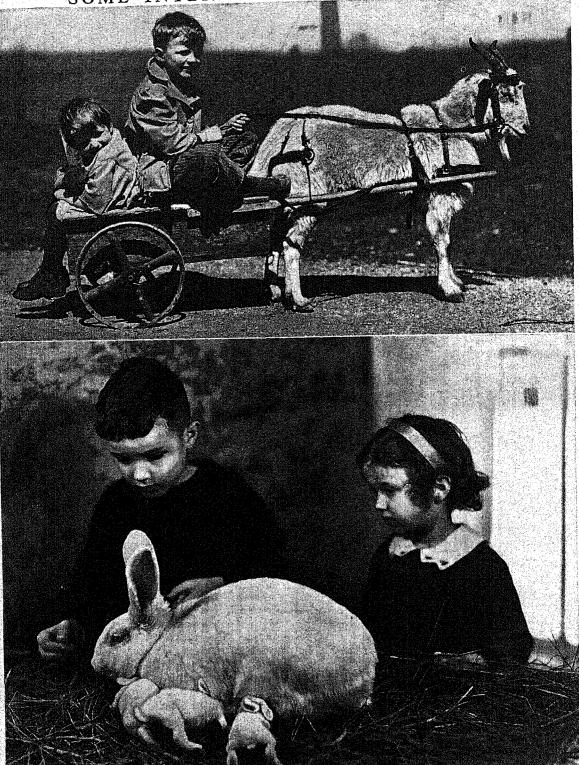
Canaries.—The ancestors of this little cheerer of the household lived on the Canary Islands and many noted breeds have been developed from them in Europe. The canary is often treated cruelly without intention. Usually the cage is too small. It should be at

least 18 inches long and high accordingly. The perches should be rounded and of different sizes, to rest the bird's feet, and should be placed so as not to interfere with its exercise; no perch should be thicker than an ordinary lead pencil. The cage should be hung where there is plenty of light, but not in a window nor in a draft nor above a gas jet. The cage should be cleaned at least every other day and fresh water for drinking given every day.

A mixture of canary grass, millet, rape, and hemp is the standard food. A little green food should be given each day. Feed chickweed, lettuce, and plantain seed stalks in summer; and sweet apple, orange, raw potato, carrot, or cabbage in the winter; dry bread soaked in milk may be given for a change. A cuttle-fish bone should be always present as an aid to digestion; it should be changed every three months. Sand should be scattered on the floor of the cage. A chance to bathe three times a week should be given. If possible the canary should be allowed to fly about the room for an hour or longer each day. During the molting season the bird should be given hard-boiled egg chopped fine with an equal amount of cracker or bread crumbs, mixed with a teaspoon of cavenne pepper, in addition to the regular diet. Almost all canaries are very fond of sugar, and small quantities of it are a desirable addition to their diet.

Continued on page 156

SOME INTERESTING OUTDOOR PETS



Pets can mean far more to children than "something to play with." Taking care of animals encourages the natural growth of a child's sense of kindness and responsibility. And many a useful hour may be pleasantly spent in learning to build pens, feeding troughs, and other things that suggest themselves to the pet owner. The two boys in

the upper picture, for example, built that wagon for their goat. Children who live in the country find goats amusing pets—intelligent and easy to feed. Below, a boy and his sister are not only having a lot of fun looking after the welfare of their rabbit family, but are also learning in a simple, natural way a good deal about the mysteries of life.

HOUSEHOLD AND PLAYGROUND COMPANIONS



For children who live in the city, dogs and cats are the most practical loyalty. The smaller boy at the right finds in his cheerful kitten a compets. And by having one of each in the house, the children soon learn panion to care for and protect. Below, the situation is reversed. The that the supposed inability of cats and dogs to get along together usuous chow is a watchdog ready to protect his small playmate sitting on the porch in the sun. Most dogs are excellent guardians for the boy and his wire-haired terrier—united by mutual affection and



Parrots. - These quaint birds come from tropical lands, and so they need special care in our colder climate. They must be kept in a warm room in winter and out of the draft. The cage should be of galvanized wire, two feet high and about the same in diameter, with a flat top. It should be provided with two good perches, the upper thinner than the lower; a ring may be substituted for the upper. The door should slide up

and down, closing by its own weight.

Parrots are fruit eaters naturally and may be given a mixture of hemp, sunflower seeds, unhulled rice, and cracked corn; ripe fruit, preferably bananas, oranges, cherries, and apples, should be given occasionally. Cuttle-fish bone is acceptable, and sand should be scattered on the bottom of the cage. Parrots should not be fed on fish, bread and milk, parsley, chick-weed, bones, meat, or grease. Baked peanuts may be given. Water should be supplied two or three times a day and the dish removed. Most parrots are great splashers when they bathe but the gray parrot prefers to roll in the dust. A piece of soft wood for the parrot to tear in pieces should be kept constantly in the cage. This will help to keep the bird busy and happy.

We should always show the parrot gentleness and affection and never laugh at it when trying to break it of a bad habit. In teaching it to talk, a lesson should be given in the morning and again in the evening, the teacher standing close to the cage and

repeating the words very distinctly.



Pigeons.—There are about 150 breeds of pigeons, including the fancy varieties. Each has a charm and beauty of its own. The first essential in a pigeon house is that it be mouse and rat-proof. This is often accomplished by interlining or covering the walls

with wire netting. The pigeon house should face southward and have a tight roof and be well ventilated. A nesting shelf should be a foot wide, partitioned into spaces a foot in length. The holes for exit and entrance to the house should be provided with a six-inch alighting board just below, both outside and inside. The house should be kept clean and should be whitewashed with lime both inside and out. It is best for pigeons to fly freely; if this is impossible, a "fly" of chicken wire must be provided.

The best food is a good quality of red wheat, Canada peas, buckwheat, hulled oats, kafir corn, and millet; hemp or rape seed is given as a treat. Do not feed barley or rice. The grain should not be new and should be thoroughly dry. Large-kerneled corn is likely to choke the birds. If they are fed only twice a day the food should be placed in hoppers. Tender green food such as lettuce or onion-tops may be given at any time. Pigeons need plenty of salt and also gravel, or crushed oyster shells mixed with coarse sand and some charcoal. They must have access to plenty of clean water both for drinking and bathing.

Crows.—Many a boy has made a pet of this very intelligent and mischievous bird and its pranks have been a joy to the boy, and the talk of the neighborhood. A pet crow should not be confined to a cage. Clip one wing and give it the freedom of the grounds and barns. It may be fed

grain and table scraps of all kinds. It particularly enjoys chopped raw meat, mice, worms, and various berries. Corn should

be softened first. It should have access to plenty

of clean water for drinking and bathing.

Turtles.—These armor-bearers are favorite pets, but they are rarely well treated because of ignorance of their habits. With the exception of the wood and box turtles and the tortoise, all of our common turtles can only eat their food when they are submerged beneath the surface of the water. If kept in aqua-



riums they are driven by starvation to bite off one anothers' tails and legs. For the water and

pond turtles the aquarium should contain two inches of water and a piece of wood or a stone projecting above the surface. It should be kept in a sunny window. Turtles need to be fed but once a week when in captivity. Raw fish and liver chopped fine are both acceptable food. The day after feeding, the water in the aquarium should be changed. (See also Aquarium; Goldfish.)

PETU'NIA. Our beautiful garden flower the petunia is a native of South America and since the 19th century has been cultivated in other countries. Through hybridizing, rich shades of crimson and rose, magnificent purples, and a number of spotted and striped varieties have been introduced. Some species, too, have deeply ruffled and fringed corollas, and some are double. The plant, except in the dwarf varieties, has

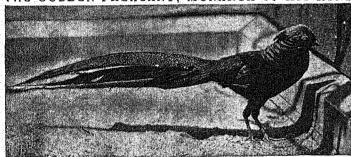
a tendency to sag and sprawl about the ground with many upright flowering branches. The finest flowers are produced in deep rich soil in sunny places. They make attractive beds and borders and are also grown as hothouse and conservatory plants.

The petunias are hybrids usually of *Petunia nyctaginiflora* or *Petunia violaceae*. They belong to the same family as the nightshade (*Solanaceae*).

PHAETHON (fā'ĕ-thŏn). This daring and beautiful vouth, whose name means "the shining one," was the son of Helios, the sun-god of the Greeks (sometimes identified with Apollo), by the nymph Clymene. In a moment of rashness Helios swore by the sacred river Styx that he would grant his son anything he asked. Phaethon asked the one thing that his father would have refused him-to be allowed to drive the chariot of the sun. God though he was. Helios dared not break his solemn promise, so Phaethon's wish was granted. He started boldly on his journey across the heavens, but very soon lost control of the fiery horses of the sun. Rushing headlong from the beaten track, they drew the sun so low that the mountain tops were scorched and finally even the trees and the grass and the grain in the fields were burnt. When Zeus saw that the whole earth was about to be destroyed, he seized one of his thunderbolts and hurled it at Phaethon, who fell like a shooting star into the river Eridanus, now called the Po. His sisters, the Heliades, who stood on the bank weeping, were turned into poplar trees, and their tears, it is said, fell into the stream and became amber.

PHEASANT (fez'ant). The pheasant is a large game bird with brilliantly colored feathers, related to the partridge and grouse. The males have long showy tail coverts. Pheasants are found in greatest

THE GOLDEN PHEASANT, MONARCH OF HIS KIND



The Golden Pheasant, because of his brilliant plumage, is a favorite for parks and "zoos." His rich scarlet body, with yellow, blue, and black markings, his crest and collar of gold, barred with black, and his long bright tail, all combine to make him the most gorgeous of his tribe.

abundance in England, where they are supposed to have been introduced by the Romans; but they may have been native to both the British Isles and southern Europe.

The common English pheasant (*Phasianus colchicus*) is about three feet long, including the tail, which represents half the length of the bird. The plumage is beautifully mottled brown and buff, with changeable lights of blue and green over the breasts of the

males. Great numbers of these birds are reared and fed artificially, and liberated in game preserves on English estates. The practice of bringing up these birds in domestication is now extensively followed, the numbers so reared vastly exceeding those that are bred wild. Eggs are collected from birds that are either running wild or kept in pens, and are placed under domestic hens, who make good fostermothers for the young pheasants.

"PLEASE DON'T STOP!"



The male English Pheasant seems easily alarmed, but the female will remain on her nest until the hunter is almost upon her, hoping he will pass on without noticing her. The nest is built on the ground, usually among dead leaves or branches, and the female hatches 10 to 12 eggs at a time.

The only representative of the pheasant family native to North America is the wild turkey (see Turkey). Chinese ring-necks were introduced into the United States about 1880 in Oregon. About the same time, English ring-necks were established in the eastern states. The birds have spread throughout the northern states and are now far more numerous than the native grouse and quail. In South Dakota alone more than a million pheasants are shot by sportsmen each year.

The male ring-neck is about three feet long, including the tail. The head and neck are metallic green and purple, with a white ring about the neck. The females are a mottled brown and black.

Pheasants are reared by state game commissions, by commercial game breeders, and by farmers. Aviary or fancy pheasants are raised for zoos and parks. The golden and the silver pheasants are especially beautiful. Scientific name of ring-neck, Phasianus colchicus torquatus. Phidias (fiditās) (about 500-430 b.c.). The greatest of all Greek sculptors, and one of the greatest in all history, was the Athenian Phidias, who alone, it was said,

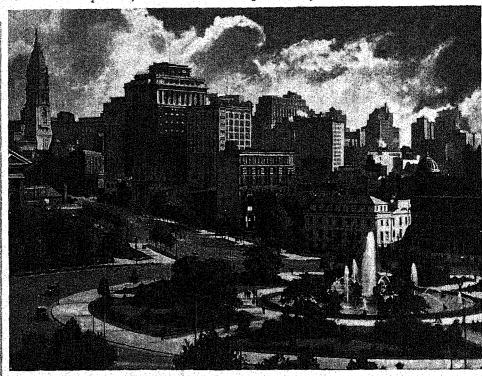
had seen the gods and made them visible to others. The information about his life is scanty and often contradictory; for our knowledge of his work, also, we are largely dependent on the statements of ancient writers, as no certain original of his hand has survived, although miniature copies show the designs of his greatest statues.

Phidias was born at Athens about 500 B.C. When he reached young manhood there came to him such an opportunity as comes to but few artists. He was appointed by Pericles, who had risen to the head of affairs at Athens, to superintend the adorning of that city with fine public buildings, and to execute the most splendid of the statues to be erected. It was largely through the genius of Phidias that Athens was made the most beautiful city in Greece, with more temples, colonnades, and other works of art than were constructed in seven centuries in Rome. He supervised the construction of the Parthenon, the magnificent temple of Athena on the Acropolis; and while the sculptured ornaments of this building were probably executed by his pupils, the giant statue of

Athena, in ivory and gold, which stood inside the temple, was the work of Phidias himself (see Acropolis). His masterpiece was a colossal gold and ivory statue of Zeus for the Olympian temple in Elis, ranked for its majestic beauty among the wonders of the world.

In his later years Phidias was accused of appropriating a portion of the gold designed for the robe of Athena. He disproved the charge; but he was then charged with impiety in having placed his own likeness and that of Pericles upon the shield of the goddess, and was thrown into prison, where he died about 430 B.C.

The STATELY Old City of WILLIAM PENN Philadelphia, the First Capital of the United States



Logan Fountain, set like an enormous jewel in Fairmount Parkway, is one of Philadelphia's many beauty spots. Dominating the scene from the left is the lofty City Hall tower, crowned by a statue of William Ponn. The Parkway originates at the City Hall and runs diagonally through the city's heart to Fairmount Park.

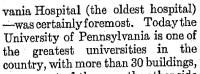
PHILADELPHIA, PA. William Penn, in his broadbrimmed Quaker hat and full-skirted Quaker coat, stands 37 feet tall, enjoying the "fruits of solitude" on City Hall tower, 548 feet above the pavements of his "dear Philadelphia." To the Schuylkill River on his left, and the Delaware on his right, runs Market Street, 110 feet wide; before him and behind runs Broad Street, 113 feet wide; and diagonally to the left stretches the splendid new Fairmount Parkway. More than a thousand buildings were torn down to make this spacious parkway. And if most of the other streets seem narrow, remember that when Phila-

delphia was planned, in 1682, twice as much space was given to streets as was then usual. Its "gridiron" plan of streets crossing at right angles has been generally followed in other American cities.

Some distance behind and to the right is Independence Square, where stands America's most famous landmark—the old state house built in 1735, now Independence Hall. Here the Second and Third Continental Congresses met, here Washington was made commander-in-chief of the American armies, and here the Declaration of Independence was adopted, while the old Liberty Bell (now preserved

HISTORIC SHRINES OF

PHILADELPHIA



most of them on the other side of the Schuylkill River, in West Philadelphia.

Another of the outsiders who helped to make Philadelphia what it is was the French-born Stephen Girard, "merchant and mariner," who helped to finance the War of 1812, as Robert Morris, another Philadelphian, though born in England, had financed the Revolution. When Girard died, in 1831, the richest man in America, he left nearly

all his fortune to public benefactions. Chief of these was Girard College for orphan white boys. Temple University, north of the City Hall on Broad Street, and Drexel Institute of Technology,

in West Philadelphia, are other notable educational institutions.

First, the house of William Penn; in the middle, the home of Betsy Ross, who according to popular belief, made the first American flag; below, Independence Hall, in which the Declaration of Independence was signed.

on the main floor) pealed forth "liberty throughout all the land." Adjoining Independence Hall on the west is Congress Hall, where Congress sat from 1790 to 1800, while Philadelphia was the nation's capital. Washington was inaugurated here in 1793, and

John Adams in 1797. A short distance east is Carpenters' Hall, built in 1772, where the First Continental Congress assembled in 1774.

At the foot of City Hall lies Market
Street, along which, one morning in 1723, munching
a loaf of bread while a pretty girl laughed at him
from a doorway, trudged a runaway apprentice
from Boston named Benjamin Franklin. It is

odd, someone has said, that Philadelphia, the most exclusive of cities, really owes most to outsiders, and of these Franklin—founder of the Philadelphia Library (the oldest subscription library in the United States), of the University of Pennsylvania, and of the Pennsyl-

Fairmount Parkway extends northwest for a mile and a half from City Hall to Fairmount Park. At its entrance to the park, facing the length of the avenue, stands the beautiful Art Museum. Its skilfully curved lines and exquisite use of color are reminiscent of the supreme achievements of Greek architecture. On the parkway, also, are the Rodin Museum, housing a fine collection of originals and casts of the works of the great French sculptor; Franklin Institute with its industrial museum and the Fels Planetarium; the Academy of Natural Sciences, oldest in America; and several municipal buildings.

Fairmount Park covers more than 3,000 acres on both banks of the Schuylkill River and Wissahickon Creek. A number of 18th-century colonial homes within the park have been restored and refurnished. Farther north, though still within the city limits, is Germantown, with its old mansions. Around the Chew mansion raged the Battle of Germantown in 1777.

Among the many other points of interest are Rittenhouse Square, near the City Hall, once the most fashionable residence neighborhood; the house in which Edgar Allan Poe wrote some of his most famous tales; the United States Mint; the Academy of Music, home of the famous Philadelphia Symphony Orchestra; and League Island Navy Yard with its warships and huge naval aircraft factory.

The City's Varied Industries

Philadelphia's advantages of location destined it to become one of the country's greatest industrial and commercial centers. Even in Colonial days it was a leading port. The Delaware River provides a broad, deep highway to the sea, 90 miles distant, and one of the largest harbors in the world. The Baltimore and Ohio and the Pennsylvania railroads make Philadelphia their general headquarters. Airports at Camden, N. J., across the Delaware River, and on Hog Island provide modern air facilities.

The city's situation as the Atlantic outlet for Pennsylvania's coal and oil makes it a manufacturing center as well as a great commercial port. The Philadelphia industrial area rivals that of Los Angeles in the value of its petroleum products. It is also a leader in refined sugar, knit goods (especially hosiery), paper, cigars, carpets and rugs, clay products, radios, lace goods, plumbers' supplies, files, and cardboard. The Baldwin Locomotive Works in the suburb of Eddystone and the E. G. Budd Manufacturing Company supply the nation with railroad locomotives and streamlined trains. The Curtis Publishing Company is one of the largest magazine publishers in the world.

Philadelphia was the capital of Pennsylvania from 1685 to 1799, the seat of Federal government from 1790 to 1800, and the most important city and port of the country during the 18th and the early 19th centuries. Two memorable events have been the Centennial Exposition of 1876 and the Sesquicentennial Exposition of 1926, celebrating the 100th and 150th birthdays of the nation. It is the third largest city in the country. Population (1940 census), 1,931,334.

PHILANTHROPY AND CHARITIES. The Good Samaritan helping a wounded wayfarer; the religious orders of the Middle Ages offering aid to the sick, the orphans, and the poor; Peter Cooper founding his Union to educate workers; Jane Addams at Hull House, playing neighbor to the children of the slums—down the years come these kindly figures, marking milestones in the progress of the age-old work of helping others.

Today philanthropy (a large word, but meaning simply "love of mankind") has grown so that on the average more than \$2,000,000,000 is given away each year in the United States alone. The problem of how best to help mankind—particularly the unfortunate—has even become a common study in university and college, and more than 25,000 professional social workers are giving their lives to this service.

Under the Wings of the Church

History's oldest records tell of almsgiving. Governments from ancient times have offered aid—usually meager—to the unfortunate. All the great religions have preached the blessedness of charity. Some confine their bounty to their own followers, but the Christian church takes all suffering humanity under its wing. For many centuries, almost unaided in the work of charity, it offered food and clothing to the poor and built refuges for orphans and the sick.

Until recent times, the benevolent had looked upon poverty and misery as fixed and necessary, and had tried to help, but not to cure. But in the 16th century, there was a movement for fixing wages by law,

and many reforms were started.

When the development of factories called great masses of people from farm and cottage to the slums of growing cities, the need for charity multiplied, and leaders arose to head a thousand and one philanthropic endeavors. Some organizations sponsored better care and instruction for the blind, deaf and dumb, and other unfortunates; the Society of Saint Vincent de Paul was formed to head Catholic world charities; the Salvation Army, the order of Deaconesses, and other Protestant groups came into being; and an ever-increasing drive began for public schools and improved educational opportunities for all.

New Times, New Problems

As problems grew, philanthropists opened their purses, more societies were formed, and men pondered deeply how best to attack these new problems. Besides giving immediate assistance to the poor and the sick, they sought ways to prevent poverty and sickness. Working toward the ideal of a world of healthy, happy, self-supporting people, they urged the spread of the school to fit folk to earn a livelihood and to live a broader, fuller life. They agitated for better housing and sanitation, better food, and purer water and air, to keep folk well; they founded hospitals, sanitariums, and dispensaries to care for the helpless in illness. Clinics for mothers and babies, medical and dental examination in the schools, school lunches, parks and playgrounds for crowded dis-

tricts, and many other child welfare services were organized through their efforts.

Laws to Aid the Worker

They campaigned for laws and regulations to shorten the working day, to improve factory conditions, and to raise wages. Workmen's compensation laws were passed to aid those injured in industry. They petitioned government agencies—not always successfully—for still greater services.

Kindly, intelligent men and women went to live among their less fortunate fellows, for they knew that really to help the poor, one must give understanding and sympathy, as well as food and clothing. They organized the social settlements sprinkled through the slums of cities (see Social Settlements), and developed the profession of the social worker.

The work of welfare societies sometimes overlapped. This led to the development of central headquarters—sometimes called Councils of Social Agencies—to coördinate the work of all groups, to keep records of each case, and of the help given by each agency.

Next, many cities bound together their welfare societies to collect funds. Each year a single "drive" endeavors to fill a city's "community chest," and the moneys are divided among its member groups.

Until a few years ago the word "charity" was generally used, but now "social welfare" is more and more taking its place because the object is to help the unfortunate to fare well. Up to the beginning of this century most of the progress in methods of charity was made by private agencies. Now both private and public agencies have improved so much that trained social workers go to either one without thinking of any difference.

Although some private agencies have institutions to take care of orphans, the blind, deaf, insane, feeble-minded, and delinquent, these classes of unfortunates are generally cared for in institutions supported by the city or state, and paid for out of taxes. Hospitals are still supported more by private philanthropy than by taxes, but most cities have health departments and free clinics for the sick.

An important phase of social welfare is providing for the support of children of widowed mothers. This was done through "mothers' pensions" granted by local governments until passage of national and state social security laws (see Social Insurance).

The object of social work is to help people to cope with their environments. Since the beginning of the 20th century the number of schools for social work has increased steadily. New and more scientific methods for dealing with social problems are constantly being developed.

Welfare workers are on the job all the time. That is how they differ from such agencies as the Red Cross, which gives help only in time of great disaster such as flood, tornado, or fire, where the need is so great that help cannot be provided locally. (See Red Cross.)

So that social workers may learn from each other's experience, there are state conferences that meet

every year, as well as the great National Conference of Social Work which is attended annually by those interested in religious, private, and public agencies.

Besides the "welfare work" described above there is another kind of philanthropy which aims at preventing the conditions which need charity by providing education and fostering research to advance man's good. Men who provide large sums of money for these purposes are called "philanthropists." The United States has more philanthropists than any other country because of the fortunes that have been made so rapidly in this wide new land through nature's abundance. Much of this great wealth is being poured out in some 150 foundations for programs of philanthropic work that know no boundaries of nation or race. The largest sums go to education, research, health, and child welfare.

The Work of the Foundations

Though only about three per cent of the billions given for benevolent purposes in America each year comes from foundations endowed by the rich to perform definite tasks, the research funds and business methods of these institutions enable them to pioneer in new fields in their work for humanity.

Benjamin Franklin set the example for his countrymen in establishing these benevolent trusts. He bequeathed to Boston and Philadelphia £1,000 each to be put out at compound interest for 100 years and then offered as loans to young married artisans of good character. Times changed, and the apprentice system died out, leaving few men eligible for the loan; but the wise old printer had provided that the trustees might later use the fund for public works, so Franklin Institute in Philadelphia and Franklin Union in Boston benefited from the fortune.

Earliest of the social service endowments was the Magdalen Society of Philadelphia (1802). In 1829 James Smithson, an Englishman, left money to found the Smithsonian Institution, whose famed research and educational work continues today. Peter Cooper's Union, founded 1857–59, still carries on its task of educating workers; and the names of Ezra Cornell, Matthew Vassar, Johns Hopkins, Leland Stanford, James B. Duke, and others are preserved in institutions they made possible.

George Peabody poured out his wealth for the support of schools in the war-torn South in 1867. About a half century later, Julius Rosenwald established a \$20,000,000 foundation to spread school-houses and health centers among southern negroes.

Among the leaders in the formation of great foundations in the United States have been Andrew Carnegie (see Carnegie, Andrew) and the Rockefellers, father and son (see Rockefeller, John Davison). Heading the Carnegie benefactions is the \$125,000,000 Carnegie Corporation, founded "for the diffusion of knowledge." The chief work of the Rockefellers is through the Rockefeller Foundation, which contributes chiefly to research in the medical sciences; and the General Education Board, which

contributes to the support of educational institutions and of educational research, experiment, and publication.

The service of the great foundations extends to the far corners of the earth. Funds for international peace; funds for medical schools in China, Siam, and elsewhere; funds for stamping out yellow fever, typhus, hookworm, and other scourges; the George Eastman gifts of some \$75,000,000 for dental clinics for the school children of Rochester, London, Rome, Stockholm, and Paris; funds for scholarships and fellowships—funds for these and scores of other international projects come from these endowments.

A Better Chance for the Child

Many of the men and women with millions to give want to help children. A large share of the Commonwealth Fund of Mrs. Stephen V. Harkness goes to child welfare in Europe and America. The \$50,000,000 Kellogg Fund gives largely to this cause, as do the Children's Fund of Michigan with its \$10,000,000 endowment from James Couzens, the Edwin Gould Foundation, and the Heckscher Foundation. The Hershey Fund educates orphan boys. Newsboys are the wards of the Harry E. Burroughs Fund in Boston.

Billions have been set aside for scholarly and scientific research—particularly in biology and medicine—and for health promotion work of all kinds. Foundation scientists peer through their microscopes, seeking the germ of one dread disease or the cure of another. Or they plunge into steaming tropical swamps in a campaign against yellow fever, sometimes sacrificing their lives to save thousands of their fellow men.

Better public health in America's cities is the aim of the Milbank Fund, which has selected two cities in which to carry out an ideal program. Five foundations support projects in mental health work.

Endowing the Artist

The arts receive about \$1,000,000 a year from endowment funds. The Juilliard Foundation aids the education of talented musical students, and several trusts provide scholarships, prizes, and the like to encourage the fine arts. The Guggenheim Foundation awards fellowships for study abroad to scholars of demonstrated ability who wish to do creative work in any of the fine arts, or to carry on research.

Many endowments aid welfare work. The Russell Sage Foundation studies social conditions and

methods and makes its findings public.

For philanthropic persons who cannot give on such a large scale there are organizations like the Commonwealth Fund of New York and the Cleveland Foundation to which people may give sums to be used by the directors as they think best.

Some of the early endowment donors planned to make their funds and their work perpetual, but sometimes the need for the fund ceased. Today, givers are providing that principal as well as interest be spent in a few years, or stipulating that the administrators may change its use to meet new problems. PHILIP, KINGS OF FRANCE. The name Philip was first introduced into the royal line of France in the 11th century by a French queen who was the daughter of the Russian czar and claimed descent from the great king Philip of Macedon. Her son was Philip I of France, 1060–1108, the first of six monarchs to bear that name; only three of these, however, call for our attention.

PHILIP II, 1180-1223, is best known by his title "Philip Augustus"; he was so called, according to a chronicler of the times, because "he enlarged (augere, "to increase") the boundaries of the state as the Emperor Augustus enlarged those of the Roman Empire." He was a contemporary of Richard the Lion-Hearted of England, and of Frederick Barbarossa of Germany; and all three went on the Third Crusade to re-capture the Holy Sepulcher from the Mohammedans under Saladin. But Philip soon took advantage of a quarrel with Richard to return home. From that time until the end of his reign he devoted his time and energy, with great success, to enlarging his kingdom and increasing his power. When he came to the throne the land over which he actually ruled was merely a small territory around Paris, while most of the present kingdom of France was held as a fief by the King of England, with whom the French ruler usually carried on continual warfare. From King John, Richard's successor, Philip succeeded in taking a great part of the continental possessions of the English kings, including Normandy, the cradle of their race. Philip II also strengthened his control over all classes of his subjects, and by encouraging the towns he lessened the influence of the powerful feudal lords. Paris now first became the regular capital of the realm, and the building of the great cathedral of Notre Dame was carried far toward completion.

One event mars the reign of this king. This was the crusade which he allowed to be waged against the Albigenses, a heretical sect in southern France. As a result of this, thousands of people were murdered and one of the fairest parts of France devastated; but it became the means of increasing the royal territory.

A Handsome and Powerful Ruler

Philip IV, 1285-1314, called "The Fair" because of his good looks, is the next Philip of France who deserves mention. He is the first example of a French king who had both the will and the means to become a powerful monarch, and he set a mark upon French life and government which has not been wiped out by the floods of successive revolutions. His reign was notable chiefly for the development of the royal power, the increase in taxation, the meeting of the first session of the Estates-General (a national assembly corresponding to the English Parliament) and for his struggle with and triumph over Pope Boniface VIII.

To understand this struggle we must note that Philip was engaged in war with England and with Flanders, and to carry on these wars he needed money. REPERSON SPAIN STAIN STAIN STAIN

After taxing laymen all he could, Philip turned to the rich churchmen for money. But the pope claimed that church property was not under the jurisdiction of the state and could not be taxed, and he forbade the priests to pay the taxes levied by Philip. In the end the king not only won the conflict with the church, but he also secured the removal of the popes from Rome to the southern border of France, where they were more easily subjected to French influence. This was the period of the "Babylonian Captivity" of the church which lasted for 70 years (see Boniface).

Philip VI, 1328-1350, was not personally of especial importance, but his accession to the throne calls for mention because of momentous consequences for both France and England. In 1328 the last Capetian king of France, Charles IV, had died without a son, and there arose the question of succession to the throne. It was decided, following a precedent set in 1314, that a woman could not rule over France, and the new principle was now added that she could not hand on her claim to a son. The throne, therefore, went to Philip of Valois, the nearest descendant

in the male line, who became Philip VI of France. His chief rival was young Edward III of England, whose mother was the sister of Charles IV. At first this decision was accepted by all, but in 1337 Edward III of England denied the justice of it, and laid claim to the throne of France on the ground that he stood nearer in relationship to the last preceding king than Philip of Valois. This claim was one of the grounds for the Hundred Years' War, which was waged, except for brief intervals, until 1456, and which ended by England losing all her possessions in France except Calais. It was this, in fact, which led her to turn her attention to the seas, where she soon reigned supreme. The war also

helped the king of France to consolidate his power into the absolutism which existed until 1789.

PHILIP, KINGS OF SPAIN. At the end of the reign

PHILIP, KINGS OF SPAIN. At the end of the reign of each of the Philips of Spain the country was a little weaker politically, a little poorer industrially, than it was when he began to rule. The first, third, and fourth of the name were so characterless that they have left no trace of their personality. Philip V, also,—the first of the French or Bourbon kings—was

"distinguished for few faults and few virtues"; but the weak-minded man acquires importance from the devastating War of the Spanish Succession (1701-1713) by which he gained his throne (see Louis, Kings of France).

Philip II in 1556 took up the burden of ruling Spain when his father Charles V laid it down, and he continued to carry it until his death in 1598. His kingdom included Spain, the Netherlands, parts of Italy, and the Spanish possessions in the New World, the other possessions of Charles V going to Charles' brother Ferdinand, head of the Austrian Hapsburgs. Is it any wonder that he failed to rule well such scattered dominions?

He was 28 years of age when his father abdicated, but he was prudent and experienced beyond his years. Dull and plodding, he was determined to do his best and to sacrifice everything to his view of duty. Unfortunately, though he was conscientious and well-meaning, he believed that his mission in life was to win world-wide power for Spain and the Roman Catholic church. His first wife, Queen Mary the

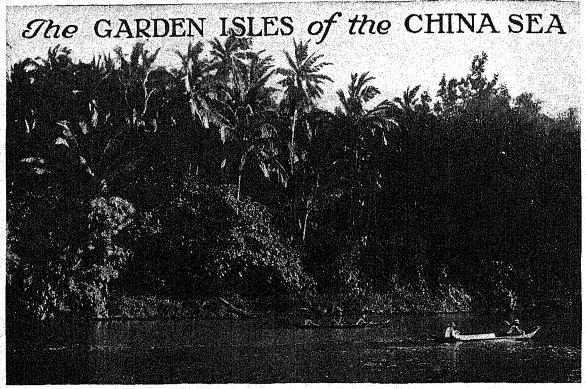
Catholic of England, died two years after he became king, and he had small chance to win England for Spain after that with Queen Elizabeth as his rival. He was no match for her in international intrigue, and even his effort to conquer England by force was a failure, for the expedition of the Invincible Armada in 1588 ended in disaster (see Armada, Spanish).

This defeat alone would not have wrecked Spain, but Philip's policy had weakened the country in other ways. His intrigues in France against the Huguenots and in behalf of the Catholic League were frustrated by the victories which brought the Protestant bred Henry of Navarre (Henry IV) to that throne (see Henry, Kings of France).

In his desire to extend the power of the church he had also encouraged the Spanish Inquisition, and he scattered over all Spain the Moriscos of Granada, the thriftiest of his people (see Moors). And his efforts to stamp out Protestantism in the Netherlands by the same means led in 1568 to a revolt under William of Orange, and to the final independence of the Dutch Netherlands or Holland (see Netherlands, Kingdom of; William, Prince of Orange).



Philip II had far reaching ambitions which brought him into conflict with leaders greater than himself. He suffered reverse after reverse at the hands of Elizabeth of England, Henry of Navarre, and William of Orange. The picture is from a portrait by Titian.



PHILIPPINE (fil'i-pēn) ISLANDS. Directly east of the Indo-Chinese peninsula and north of the East Indies and Australia are the Philippine Islands, so far away from their guardian, the United States, that when it is 12 o'clock noon in

New York City it is 1:03 a.m. "tomorrow" in Manila. They lie wholly within the tropics, so that if they could be brought straight across the Pacific to the American continents they would extend from the middle of Mexico to the middle of Colombia, South Populated almost entirely by people of the colored races, these distant tropic islands seem strange wards for the United States. And, indeed, its guardianship—which began in 1899 when the Philippines were acquired by conquest and purchase from Spain—is being relinquished as the Filipinos are becoming educated to self-government. The islands already have a large measure of independence and in 1946 will become entirely free from American control.

Scattered in haphazard fashion between the China Sea and the Pacific Ocean, the 7,083 islands of the Philippines form an archipelago almost as large as that of Japan proper. Luzon, the farthest north of the large islands, is equal in area to Ohio; and Mindanao, in the extreme south, is as large as Indiana,

Extent.—Extreme length of archipelago, north to south, about 1,100 miles; east to west, nearly 700 miles. Total area, 114,400 square miles, of which about two-thirds is contained in Luzon and Mindanao. Population, about 16,000,000.

Natural Features.—About 7,083 islands, largely of volcanic formation.

traversed from north to south by irregular mountain chains. Highest peak, Mount Apo (on Mindanao), 9,610 feet. Moist tropical climate, with frequent hurricanes and earthquakes.

-Corn, rice, manila hemp, sugar cane, coconuts, copra, coffee, cacao, bananas; water buffaloes, cattle, hogs,

tobacco, coffee, cacao, bananas; water buraloes, cattle, nogs, goats, sheep; cigars and cigarettes, sugar, cocoa, coconut cil; lumber, rattan, bamboo; gold, iron, copper, chromite, manganese.

Cities.—Manila (capital), about 625,000; Cebu and Zamboanga, over 125,000; Davao and Hoilo, over 90,000; Baguio ("summer capital"), in mountains of Luzon.

Between Luzon and Mindanao are eight other islands of considerable importance, while to the southwest is the long narrowisland of Palawan. Hundreds, however, are so small that they are mere specks on the ocean, inhabited only by sea

birds. All but 462 out of the 7,083 islands occupy areas of less than one square mile apiece.

On all the larger islands the scenery is made beautiful by high mountain ranges and by the diversity and abundance of the tropical vegetation. The Philippines have no deserts, nor even barren lava beds. More than half of the entire surface is covered with forests, many of which, in the mountainous interiors, are inhabited by savages and have never been fully explored. There are about 50 volcanoes scattered about the archipelago, some of which are still active. Of these the most beautiful is Mayon, in southern Luzon, a perfect cone rising to a height of almost 9,000 feet, its lofty crater perpetually enveloped in a great cloud of vapor; and the most remarkable is Taal, situated in the midst of a lake near Manila, which has a crater containing several lakes of many-colored boiling liquids. In the last three centuries Mayon has had several eruptions of great violence, and in 1911 Taal poured forth a flood

THE BIRTH OF THE COMMONWEALTH OF THE PHILIPPINES



This building in Manila houses the National Assembly of the Philippine Commonwealth. The picture commemorates the birth of the new nation. It shows the crowd at the inauguration ceremonies of the first president, Manuel Quezon, on Nov. 15, 1935.

LEFT BEHIND BY

of fire and ashes which took more than 1,300 lives. Slight earthquake shocks are so frequent in most of the islands that they scarcely arouse comment. There is an average of more than 100 such dis-

turbances in Manila each year. Yet volcanic forces destroy little compared to what they have given; for it was chiefly by their means that the islands were raised above the sea.

Summer and winter are much alike in the Philippines; it is always warm, except on the high mountain tops. The surrounding ocean makes the climate equable, Manila (the capital) having an average variation of only

So between winter and summer temperatures. The Spanish described the weather briefly as "six months of dust and six months of mud," but these seasons do not coincide throughout the archipelago. When it is very wet in one place it is dry in another, so that one could move about so as to escape the rains altogether. From June to November the southwest monsoon waters only the west side of the mountains, while from November to June the monsoon blows in the opposite direction, making the east side rainy.

During the rainy season the much-dreaded typhoon or "baguio" does its deadly work. Hour after hour the rain descends in sheets, driven almost horizontally before a furious gale, overturning small houses and

sending insecure roofs and shutters sailing away. As many as 2,000 people have been lost in one of these storms.

Probably in no other part of the world are there so many distinct peoples on a small area as in the Philippines, where even the small islands have many districts isolated by high mountains and jungle growth. The original inhabitants were pigmy blacks, the Negri-



THE AUTOMOBILE

Not long ago, the water buffalo, or carabao, supplied nearly all the transportation in the Philippines. Today he watches automobiles and trucks speed past his lumbering cart.

tos or "Little Negroes," one of the most diminutive peoples in the world. Like the African negro they have crispy hair and wide noses, but they rarely attain a stature of five feet, and seldom live to be 50 years old. For the most part the 30,000 Negritos are still true savages, building no houses, and depending chiefly on the game they kill with their bows and arrows. Being of a timid disposition, these tiny black men keep to the deep forests, where they were driven by the Malays, and give little trouble. The Igorots

VILLAGE LIFE IN THE PHILIPPINES



The native houses of bamboo and grass are raised high above the ground to keep out dampness, snakes, and vermin. The thatched roofs are steeply pitched to shed the rains and to provide coolness. No nails are used, and the walls are lashed together with ratian cords. Note the quaint but becoming dress of the women, with full skirts and sleeves. At the right is one of the many artesian wells bored by the Americans to prevent the formerly prevalent diseases caused by drinking impure water.

and other allied mountain tribes are a much more numerous savage people, who keep to the mountains as persistently as the Negritos to the forests. They live chiefly in central Luzon, and are more advanced

than the Negritos. They till the steep hillsides by a wonderful and laborious method of terracing. They are strong and enterprising, of medium height, with mixed Chinese and Malay blood. A few of the more warlike tribes still take the heads of their enemies in tribal feuds as they did when Spanish occupation began; but the majority are peaceful and contented, Hundreds of Igorot children are now in the public schools.

The most formidable group with which the Spaniards and the Americans had to deal were the Mohammedan Moros of Mindanao, numbering about 400,000. Driven out from the northern islands by the Spaniards, they concentrated in southern Mindanao and in the Sulu (or Jolo) Islands southwest of it. They hold a considerable portion of Mindanao, the second largest of the islands. Never having

been conquered by the Spaniards, the Moros clung to their independence and resisted American rule. They suffered their first serious defeats in 1902 and 1903 when Gen. John J. Pershing led troops against them in Mindanao, and Gen. Leonard Wood quelled an uprising in the Sulu Islands. Although troubles are not infrequent in Moroland even to this day, the Moros are much more peaceful now than years ago and no longer constitute a serious problem to the govern-

ment. Educated Moros are employed as public school teachers, government employees, and army officers.

The Filipino People

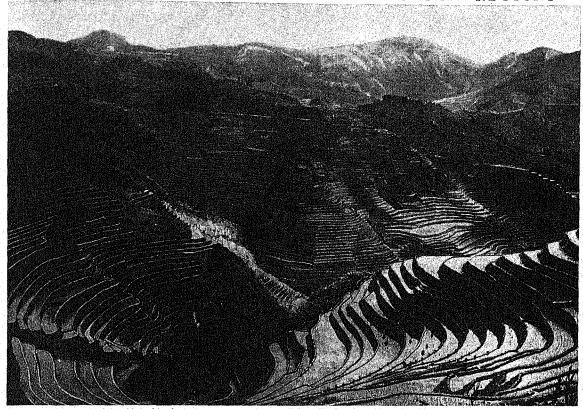
The seven great tribes in the Philippines who have been christianized are known as the Filipinos. They are a small slender race with brownish-yellow skin, narrow black eyes, and heavy, straight, black hair. It is almost certain that these people came to the islands some time after the arrival of the Igorots and other pagan tribes and forced those less cultured peoples back to the mountains. They had a written language when the Spaniards found them, and other elements of civiliza-Consequently, it is with the Filipinos that the missionaries of Spain and America have been chiefly concerned. From the intermarriage of Filipinos with Spaniards has sprung another type, called mestizos,



Weeding the rice fields is an occupation that usually falls to the lot of the women. This Igorot woman wears a jacket and a sarong—a wrapped-around skirt—instead of the semi-European garb of the women shown above.

a numerous and powerful class whose influence is strongly felt in political and industrial affairs. The admixture of Chinese blood has also profoundly modified the early Filipino type, for the Chinese came to the islands long before the Spaniards. Though the

THE TERRACED RICE LANDS OF THE MOUNTAIN REGIONS



At first glance, you might think this the ruins of some gigantic amphitheater, but in reality it is a striking view of the terraced rice lands in the mountainous regions of the Philippines. These protecting walls are built, one above another, to retain the water and hold the precious soil in place so it will not be washed away by the tropical rains.

Chinese are only a tiny fraction of the population, they play an exceedingly vital part in the economic life of the islands. About two-thirds of the retail trade and a considerable number of the other business enterprises are in their hands.

How Public Health Has Been Improved

The Spaniards christianized the Filipinos—a remarkable missionary achievement—but there they stopped. In the three centuries of their rule they did practically nothing in the way of public improvements and education. They built few roads. Instead of fostering the teaching of Spanish, they discouraged it, leaving the people unable to communicate with those outside their own tribes. When the Americans entered Manila, they found it one of the foulest places in the Far East. Pure drinking water did not exist. Lepers were left free to go where they wished, and great scourges of smallpox, cholera, and bubonic plague came and, through lack of medical knowledge to check them, spread until they died out of themselves.

Into the then disease-ridden country the Americans brought a constructive program that would have been stupendous even in the United States; in the Philippines it was complicated by the ignorance of the people. The superstitious natives attributed diseases to evil spirits, and refused to believe that boiling

water before drinking it would prevent much sickness. But slowly the health authorities won their fight for pure water. Hundreds of artesian wells were drilled, and by that means alone the death rate was cut in half in many provinces. A successful campaign was made against tuberculosis, with which, it is estimated, one-third of the Filipinos were infected. The Philippine Islands Anti-Tuberculosis Society, which is supported partly by the government and partly by private contributions, was organized and through its initiative a modern sanatorium was established. Traveling X-ray clinics are sent to many parts of the islands. The spread of leprosy has been checked, principally through the establishment of the Culion Leper Colony and other leprosariums. In Culion, which is the outstanding leper treatment station in the world, with its own churches, stores, and theater, live some 7,000 patients—once hopeless, but now encouraged by the many cures that have been effected.

Education for the Millions

Hand in hand with the campaign for health went a program of education. American soldiers began, and American school teachers carried on, a school system that was at first much like that of the United States. Thousands of Filipino teachers were educated in the United States. But the need of training millions of

THE COMMONWEALTH'S CAPITAL OF LEARNING

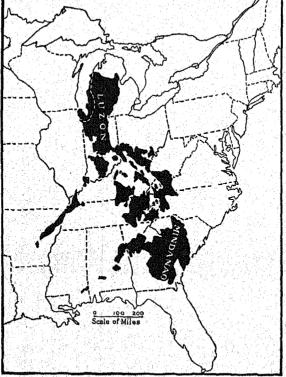


The University of the Philippines, proud of its magnificent library, which is shown above, is an index to the educational progress of the whole commonwealth. From a small school of agriculture, the university has grown into an institution of several thousand students, who may select courses in agriculture, medicine, law, engineering, liberal arts, education, music, or other fields. The free public elementary and secondary schools have had a similar growth. They now instruct more than 1,250,000 pupils.

unskilled handsformanual labor soon became evident, and now industrial training has largely replaced the old curriculum. Basketmaking, weaving, carpentry, and agriculture are being emphasized, as well as athletics. Today one will see as many baseball games in progress in Manila as in any American city of the same size. English and Spanish are taught in the schools, but Tagalog has been made the national language. A striking indication of educational progress is the fact that thousands of students have received degrees from the University of the Philippines at Manila since its foundation in 1908.

Crops and Problems

Agriculture receives special attention from government bureaus as well as from schools, be-

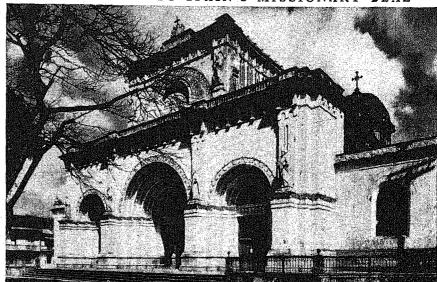


This composite map shows you the size of the Philippine Islands, as compared with the eastern half of the United States.

cause nearly all the national income is derived from crops grown for export. Fine climate and soil produce enormous yields. A huge acreage is devoted to crops for export, notably sugar, and as a result not enough rice, wheat, vegetables, fruit, and live stock are raised to supply home needs. Hence diversified farming is encouraged. Under this plan, farmers raise a variety of products needed at home, as well as crops for export. Experiments are being made with new crops and with new breeds of cattle. The chief domestic animals are the pig, the cow, and the water buffalo, or carabao, which is used both as a draft animal and for food.

Manila hemp is a major crop. This is not a true hemp but comes from the long leafstalks of the

A MONUMENT TO SPAIN'S MISSIONARY ZEAL



This is the Roman Catholic Cathedral of Manila, one of the many church buildings that recall the three centuries of Spanish rule and missionary effort in the Philippines. Most Filipinos are Catholics, but the Moros are Mohammedans and many tribes are still pagans.

abaca plant, which belongs to the banana family. The abaca plant is native only to the Philippines, but plantations have been developed in other tropical regions, especially the East Indies. Manila fiber makes strong, durable, and water-resistant rope. Many thousands of tons of it are exported annually. Maguey, another useful fiber plant (related to the American century plant), is also extensively cultivated.

Sugar is the most valuable of the crops grown for export. Fifty million dollars' worth or more is shipped to the United States every year. Tobacco is another large

crop. Most of it is consumed at home, since nearly all the Filipinos smoke—men, women, and children—but large quantities of cigars and leaf tobacco are exported to the United States and other countries. There are more than 100,000,000 coconut palms, and more copra (the dried meat of the coconut) is produced here than in any other country.

Rice is the most valuable of the crops grown for home use, because with fish it serves as the principal food of the Filipinos. Melon-like mangoes and papayas, oranges, and similar delicious fruits thrive in the islands. Corn, sweet potatoes, coffee, and cacao beans are other agricultural products.

Resources That Await Development

Forests are a chief source of national wealth, for they cover more than half the area of the Philippines, and they contain, besides bamboo, hundreds of varieties of hardwood. The bamboo tree supplies material for the houses and furniture of the natives. The hardwood trees supply lumber for export, mainly to the United States, and so add millions of dollars to the national income each year. This, however, is but a small fraction of what the forests can earn when enough roads are built and adequate shipping facilities are provided. Since American occupation, about 1,000 miles of railroads have been built (chiefly in Luzon) and several thousand miles of roads.

Mines, Manufactures, and Imports

The islands are rich in minerals, especially gold, copper, iron, manganese, chromite, and coal. The mining industry has been rapidly expanded in recent years. The islands now contribute a substantial part of the world's gold supply. Many manufacturing industries are carried on in the home. Some of the finest embroidery in the world is produced by the Filipino

women, who also make hats, mats, baskets, lace, and hand-woven cloth. Other manufactures, notably the cigar and cigarette industry, are conducted in factories equipped with modern machinery. There are many rice mills, sugar mills, hemp stripping plants, and saw-mills. Home manufactures, however, do not meet the needs of the Philippines. From the United States they buy iron and steel manufactures, automobiles and tires, electrical machinery, petroleum products, cotton goods, meat and dairy products, wheat flour, tobacco products, and paper. They also buy cotton goods from Japan, meat and dairy products from the Netherlands, and flour from Australia. In some years, they import much rice from the French East Indies.

History of the Islands

The Philippines were discovered by Ferdinand Magellan, who entered Cebu harbor in April, 1521. During a skirmish with the natives he was killed, but his ships went on and made the first journey around the world. In 1542 Ruy Lopez de Villalobos attempted to conquer the islands and named them "Filipinas" in honor of Prince Philip of Spain. In 1565 Miguel Lopez de Legaspi arrived from Mexico with 400 colonists, in addition to a group of friars, and founded the first Spanish settlement on the island of Cebu. Before his death in 1572 he completed the conquest of the islands and explored a large part of the territory. Spain was mainly interested in christianizing the islands, and the religious motive dominated its policy for more than three centuries. But when Spain lost its possessions in North and South America early in the 19th century, the Philippines were the richest possession left, and the spirit of colonial exploitation grew.

In 1896 the Filipinos, led by Emilio Aguinaldo, rose in rebellion. Two years later the United States went MID TO TO THE POLICY

to war with Spain (see Spanish-American War). On May 1, Commodore Dewey totally disabled the Spanish fleet in Manila Bay (see Dewey, George). On August 13 American forces occupied the city, and on April 11, 1899, the Philippine Islands passed formally into the hands of the United States by virtue of the Treaty of Paris, after payment of \$20,000,000 to Spain. Aguinaldo's army, which had been fighting the Spaniards, now attacked the Americans. Hundreds of engagements followed until the final subjugation of the islands and the capture of Aguinaldo on March 23, 1901. On July 4 a civil government was established, with William H. Taft, later president of the United States, as governor general. In 1916 a large measure of self-government was granted when the United States Congress passed the Jones Act, providing for a Philippine legislature elected by popular vote.

But Filipinos, and many Americans, continued to demand complete independence for the islands. In 1934 the United States Congress passed the Tydings-McDuffie Act, which established a Commonwealth government in 1935, and provided for full independence on July 4, 1946. The transition period of little over ten years was provided to enable Filipinos to practise selfgovernment, supervised by an American resident high commissioner appointed by the United States. Throughout that period the United States was also to retain control of defense, foreign relations, and major finance. The Commonwealth constitution, as revised in 1940, provided for a president and vicepresident elected for terms of four years and eligible for only one re-election. It also established a congress of two houses, elected by popular vote. The right to vote had been granted to women in 1937.

The first president was Manuel L. Quezon, who had been the outstanding political leader of the islands for 25 years. He was elected in 1935 for a six-year term and re-elected in 1941 for a second term.

Situated less than 1,000 miles south of Japan and only about 300 miles off the mainland of East Asia, the Philippines lay in the path of Japanese expansion. By 1941 the threat of Japanese invasion loomed large. In answer, the United States in July 1941, took direct control of the Philippine armed forces. Gen. Douglas MacArthur, who had been military adviser there since 1935, was given command (see MacArthur, Douglas). Defense of the islands rested chiefly on the small United States Asiatic Fleet and a few American soldiers, aided by the small Commonwealth army. Protective measures were rushed. But on Dec. 7, 1941, Japan attacked from the sea and the air without warning. Manila was heavily damaged, and by May 6, 1942, the islands were under Japanese control (see Manila; World War, Second). But President Quezon and other officials escaped to the United States and set up a government in exile with headquarters in Washington, D.C.

PHILIS'TINES. When the Israelites entered the Promised Land, among the tribes which they found there were the Philistines, who proved to be their greatest enemy. They were the strongest of the Canaanite tribes, and acquired so much power and influence that the whole country became known as Palestine, or the land of the Philistines. Their group of five cities-Gaza, Ashkelon (Ascalon), Ashdod. Gath, and Ekron-formed a small district on the coast of the Mediterranean, southwest of Israel. It is thought that they were of the Mediterranean race and came originally from Crete. Their religion was an idolatrous worship centering about Dagon, a god represented as part man, part fish. Like the Semitic Phoenicians, to the north of Israel, they were a seafaring people; but while the Phoenicians confined themselves to peaceful pursuits, the Philistines continually harassed the Israelites and sought by conquest to extend their territory to the east. They finally fell before the great conquerors who one after another swept Palestine—the Assyrians, Babylonians, Persians, Ptolemies of Egypt, Seleucids, and the The name "Philistine" is today used as a Romans. term of contempt for narrow-minded persons.

The LONG and VARIED HISTORY of WORDS

How Words, Like People, are Born, Grow Old, and Die—Some Change Their Occupations and Any of Them are Likely to Have Queer Relations

PHILOLOGY (fi-löl'ō-ġy). Language grows much as a tree grows—the big simple things first, like the roots, and the trunk, and the main branches. Then come the thousands on thousands of little separate words, like the leaves of the tree, each related to the others and yet different in size and position. It has been found that all languages obey much the same general laws, and the study of different tongues and their relationships is called "philology"—from Greek words meaning "the love of the word."

Language is still growing, growing and changing all the time, though you may not notice it. New words are being added and old words dying, and some words are changing their meaning under our tongues. Probably the main outline of a language will not change so much as it did in former times, because of printing and the general spread of knowledge. But smaller changes will always take place.

Take for instance an old English word "frampold," which was a good word in Shakespeare's time, and meant "peevish." It grew old like a yellow leaf, and fell away. Nobody today would have any idea what you meant if you spoke of "a frampold woman." On the other hand Shakespeare would not have the slightest idea what you were talking about if you could speak to him about a "telephone." But one of the most curious things is the way a word will sometimes remain in the language but change its meaning. The word "imp," for instance, once meant "offspring" or "scion," and there is a dignified old epitaph still in existence which begins, "Here lies that noble imp." How ridiculous that sounds today! Or take the word

"host," which comes from the Latin hostis meaning "enemy." It has been so altered in meaning that now it means any army or large body of people, your own quite as well as your enemy's.

Philologists, or students of language, have discovered many interesting and unexpected things by this comparing of languages. By tracing the words from one tongue to another, and back to their original meanings, they have found for instance that many languages which at first sight seem to have nothing to do with one another are really related, much as cousins are related. And they have been able to puzzle out a good many facts about the original language from which many of the modern languages have developed. So philology helps out the other branches of science which deal with early man before our recorded history began.

Probably the most interesting discoveries have been in connection with the Indo-European languages, to which group our English language belongs. These languages are also called Aryan, and the people who spoke them were once all classed as Aryans; but now-adays the term Aryan as a race name is applied only to the eastern branch of the Indo-European peoples.

The scientists first made these discoveries by finding that Sanskrit, a dead language of India, was really a sister tongue to Greek and Latin and to the Germanic languages to which English belongs. With this as a key they were able to group almost all the languages of Europe and some of those of Asia into a system, and to make a good guess as to their origin.

The Mother Home of European Tongues

What they now think is that the original Indo-European root language grew up in the grasslands of the Caspian Sea. In course of time the people began to migrate, some going east and some west. As they got separated farther and farther from one another, and as the years passed, differences began to appear in their languages. At first if they met accidentally they could undoubtedly still understand one another, as a man from Boston can understand a man from Mississippi, though their speech is quite a little different. But after a few centuries these different groups grew so far apart in language that they could not understand one another at all, just as you cannot understand German without studying it, though English and German are rather closely related.

But certain words, or rather the "roots" of certain words, are found in all these languages, so we can be sure these words existed in the mother language. For instance, our English word "mother" is "mutter" in German, "mater" in Latin, "mētēr" in Greek, "matar" in old Persian, "macar" in Tokhar (Central Asia), and "mātā" in Sanskrit. By examining carefully which words are found thus in all the group languages the philologists have been able to make out certain things about the people who made the language in the first place. They seem to have been an agricultural people, with domesticated animals, and a definite form of government, and to have been in some

ways rather highly developed, for their language had a complicated grammar, much more complicated in certain ways than our English language is today.

The study of comparative philology began in the last part of the 18th century. Sir William Jones in England had perhaps the first vision of its scope, but two Germans, Franz Bopp and Jacob Grimm—yes, he's the same one who helped collect the fairy tales—did the first thoroughly scientific groundwork. Max Müller, another German who taught at Oxford, also wrote many books on the subject. And today there are a host of philologists studying the subject, and every language and dialect, even the most unimportant, is being carefully studied.

Word Biographies in Your Dictionary

If you take any good unabridged dictionary you will find the "etymology," or history of the word, usually given in parenthesis after the word itself. These histories are often very interesting and they give the word a depth of meaning which you would never suspect otherwise.

The Indo-European group of languages mentioned above is divided into a number of smaller groups, of which the principal are: the *Hellenic*, which includes all the old Greek dialects; the *Italic*, which includes Latin and all the modern languages that come from Latin and are usually called Romance languages (Italian, French, Spanish, Portuguese, etc.); the *Celtic*, including Welsh, Gaelic, etc.; the *Teutonic*, including German, Norwegian, Swedish, Dutch, English, etc.; the *Slavonic*, including Russian, Polish, Serbian, etc.; the *Indic*, which includes Sanskrit and ancient Indian dialects, as well as the various modern dialects derived from these, like Hindustani; the *Iranic*, comprising Persian and several allied tongues; and the *Anatolic*, including Armenian, Phrygian, etc.

These Indo-European languages all belong to what is called the "inflected" languages; that is, they have a more or less complicated system of grammatical changes to indicate case, number, person, tense, and the like. There are however two other types of language. One type is inflected to a smaller degree than the Indo-European tongues, but has still the addition of prefixes, suffixes, and infixes to the root word. These are called "agglutinative" languages. To this class belong Turkish, Mongolian, many American Indian languages, etc. The third class is called "isolating," because in these languages each rootword, which represents a root idea, is a single monosyllable without additions of any sort. Chinese is the principal language of this group.

The languages which do not belong to the Indo-European group are divided into a dozen or so other groups, of which the most important are the Semitic family, which includes Hebrew, Phoenician, Arabic, Abyssinian, Syrian, etc.; the Hamitic family, which comprises Egyptian, Coptic, etc.; the South-Eastern Asiatic, or monosyllabic family, of which Chinese and Tibetan are the principal examples; and the American family, including the American Indian tongues.

Next to the Chinese, which is spoken in its various dialects by nearly 400,000,000 people, the English language is the most widely distributed, being spoken by about 160,000,000. It is said that German is spoken by about 110,000,000; Hindustani, 100,000,000; Russian, 100,000,000; French, 70,000,000; Japanese, 55,000,000; Spanish, 50,000,000; Italian, 50,000,000.

PHILOSOPHY. "It was owing to wonder," said Aristotle, "that men first began to philosophizewondering at first about the problems that lie close at hand, and then little by little advancing to the greater perplexities." In this sense we all are occasionally philosophers. We philosophize when we reflect critically upon what we are actually doing in the world, upon the meaning of life, upon right and wrong, or how there came to be a world at all. The professional philosopher does, as his constant business, what other people do at moments. Touchstone's question-"Hast any philosophy in thee, Shepherd?" -is one with which Prof. William James says men should always meet one another; for "a man with no philosophy in him is the most inauspicious and unprofitable of all possible social mates.'

The word "philosophy" comes from the Greek philein, meaning "to love," and sophia, meaning "wisdom." Hence "philosopher" originally meant "a lover of wisdom"; and although the word has since come to mean many things to many men, in its full sense it is only man thinking—thinking about generalities rather than particulars, trying to see all time and existence as a whole.

Today a study of the world and science and society is divided into many divisions. But at first there were no such separate departments of study, and the early philosophers studied subjects which today would be called astronomy, physics, or natural history, as well as logic, ethics, and metaphysics, which are now called philosophy. When we separate off one particular aspect of the world or of society and study that by itself, we usually call this a science; especially if we study something which we can count or measure exactly; but on the other hand if we aim not to get a precise statement of one particular part but instead try to find the meaning of the whole, we call it philosophy. Even in modern times Sir Isaac Newton, who formulated the laws of gravitation, is usually spoken of as a philosopher because he was taking a broad view of things.

Used in this same wide sense, philosophy has also a moral implication. Thus we often hear, "He took it philosophically," or "He is a real philosopher," when what is meant is little more than that his feelings were properly controlled by reason.

In a narrower and more technical sense, philosophy means metaphysics—the discussion of various abstract questions, all of them very broad and deep, which sciences and life suggest but do not solve. The sciences use such words as space, time, matter, and causality, without examining the meanings of the

words; metaphysics asks such questions as: What are space and time? What is meant by a "thing," and how does it differ from an "idea?" How are mind and body joined? Do they act on each other? How does anything act on anything else? Is good a matter of opinion only, or does it have some existence outside of the mind? Metaphysics inquires into the cause, the substance, and the outcome of all things.

When you are judging right and wrong (which is the province of the branch of philosophy we call ethics) some consider that we can decide by reason; others believe that right and wrong are rather matters of feeling. When we ask what standard shall we actually use, some have held that the most important thing is whether our conduct produces happiness, and others whether it enlarges our life by making us more perfect. The first school are called hedonists, from the Greek word that means pleasure or happiness; the other school have been called by various names but most frequently idealists. Hedonists are further subdivided according as they emphasize the happiness of the person himself or the happiness of others as the true test. The first are called egoists, or sometimes epicureans, because the Greek philosopher Epicurus was the founder of a school which held this doctrine; the second group are sometimes called altruists. One particular group of altruists who were active in England in the early part of the 19th century are called utilitarians, or Benthamites after the English philosopher Jeremy Bentham (1748-1832). Their maxim was "the greatest good of the greatest number."

"Things" and "Thoughts"

Our knowledge of nature and our views about life may be regarded as having two parts. On the one hand we have to see or hear or touch, and on the other. we have to arrange or organize in our minds our ideas about what we see and hear and touch. We raise such questions as "What are things made of?" and "What is the cause of this or that?" Now some philosophers have emphasized the first of these subjects, and have thought that the particular things that we see and hear and touch are the more important. They then aim to form some general principles from examining these particular facts. This method is called induction, and the philosophers who use it are called empiricists, which means that they rely upon experience. On the other hand, some philosophers have been most impressed by the fact that if we can find a general law, such as that of gravitation, or set up some general standard of right and justice, we can then proceed to understand or judge particular facts by bringing them under this general law. If the book falls from the table, we explain it by saying that it is due to the law of gravitation. To begin with a general law or rule and proceed to particular cases is called deduction, and the philosophers who have tried to understand the universe by first grasping its general nature are called rationalists. They believe that by pure reason it is possible to make many statements about what must happen or what men ought to do.

A newer school, called pragmatism, has still another method of approaching these problems. Every idea, says Professor James, may be tested by the question, "What sensible difference to anybody will its truth make? If you claim that any idea is true, assign at the same time some difference that its being true will make in some possible person's history, and we shall know not only just what you are really claiming, but also how important an issue it is, and how to go to work to verify the claim." This method neglects the content of an idea and follows its use only, under the theory that the use is the real test of its truth and meaning. The idea is true and its truth demonstrated if it works.

Pragmatism was first formulated by C. S. Peirce, an American scientist. Prof. William James developed and popularized it and became the leading pragmatist. Prof. John Dewey belongs to this school.

When you study the world it is very evident that there is a sense in which there are a great many separate things, such as rocks and trees and persons; there is also a sense in which we say that our body is one thing and our mind is another. But on the other hand it seems equally clear that all these separate things are in some sense related to one another; that is, are not entirely separate but, as it were, one. A man's mind and body together make up one person, and every part of the universe is probably affected by every other part. Those philosophers who have emphasized the unity of the world are called monists, and those to whom the distinctions and separateness between things seem most important are given the name of pluralists.

Materialism and Idealism

Perhaps the simplest distinction in our world is that between persons and things. Persons are alive and think and move of their own will; things do not move unless they are acted upon by some other thing or by a person. Some philosophers have thought of the world as though it were all made up of things, or to use the technical term, of matter. They have been called materialists. Others have believed that the world is to be regarded rather as though it were to be understood also as mind; and they have been called idealists.

Besides metaphysics and ethics, there are two other important divisions of philosophy; logic, which is the science of thinking and of classifying arguments into good and bad; and aesthetics, the science of the beautiful, in its broad sense—including the sublime, comic, tragic, pathetic, and ugly.

The first people to think systematically about the great questions of the universe and give philosophy a meaning were the ancient Greeks, represented by such famous names as Thales, Heraclitus, Democritus, Aristippus, Socrates, Plato, Aristotle, Pythagoras, Epicurus, Zeno, and Diogenes (see Aristotle; Epictetus; Plato; Pythagoras; Socrates).

The Romans borrowed their philosophy, as they did most of their arts and sciences, from the Greeks. Lucretius, Cicero, Marcus Aurelius, Epictetus, Plotinus, and Boethius all carried on the Greek tradition in one form or another (see Cicero: Marcus Aurelius Antoninus). After three centuries of intellectual darkness, a new school of thinkers arose, who attempted to harmonize the doctrines of Aristotle with the teachings of the church. This system, known as Scholasticism, was the creation of such famous medieval philosophers as Duns Scotus, Thomas Aquinas, Peter Lombard, Abelard, Anselm (see Abelard).

The stimulating influence of the Revival of Learning burst the fetters of scholasticism and impelled men to strike out into new paths of philosophic thinking. Francis Bacon, the great English philosopher, laid the foundations of modern empiricism, and the Frenchman Descartes established the principles from which modern rationalism sprang (see Bacon, Lord Francis).

During the last three centuries important contributions to philosophic progress have been made in each of the leading nations of Europe, as well as in our own country. The outstanding names in England are Thomas Hobbes, John Locke, George Berkeley, David Hume, Dugald Stewart, Jeremy Bentham, John Stuart Mill, Herbert Spencer, T. H. Green, and F. C. S. Schiller. Germany produced such epochal thinkers as Leibnitz, Kant, Fichte, Schelling, Haeckel, Schopenhauer, Nietzsche, Hartmann, Lotze, Herbart, and Wundt. France is represented by Malchranche, Condillac, Diderot, Rousseau, Voltaire, Comte, Cousin, and Henri Bergson. Holland produced the great Spinoza. The United States is chiefly known by the work of Jonathan Edwards, Ralph Waldo Emerson, Josiah Royce, William James, George Trumbull Ladd, John Dewey. (See Emerson; Rousseau; Voltaire.)

These hardy garden flowers yield a PHLOX. wealth of bright-colored clustered blossoms throughout the summer and early autumn. About 30 species are native to North America. The tall-growing showy border phloxes have salver-shaped flowers, ranging in color from pure white to almost bright scarlet, passing through shades of pink, purple, magenta, lilac, and salmon. They are divided into early and late blooming kinds, the most common variety of the latter being cultivated from the wild sweet-william (Phlox maculata). The dwarf perennials, trailing and tufted in habit, make a charming edging to our flower beds. They too have great variety of color, and succeed in poorer soil and drier places than the tall plants. Perhaps the best known of these is the moss pink. It grows only about six inches high and has prostrate stems and dense masses of blossoms that completely hide the thick mats of mosslike foliage. In early May it makes a brilliant carpet in our gardens.

Scientific name of moss pink, *Phlox subulata*. Flowers about one inch across, growing in small clusters; five-lobed tubular calyx; salver-shaped corolla of five lobes, notched or entire; five stamens in corolla tube; stem matted, much branched, leafy; leaves crowded, narrow, sharp-pointed, usually stiff with hairy margins.

PHOENICIANS (fe-nish'i-anz). More than 2,000 years before the days of Columbus, keen-eyed dark-skinned mariners anchored their well-laden ships from Phoenicia off many a shore of the blue Mediterranean and even beyond in the unknown seas. The people came flocking down to purchase their wares, for the Phoenicians were the great merchants of ancient times. Through their hands passed the rich treasures of every known land—perfumes and spices from the Far East; fine linen from Egypt; wool from Arabia, woven into robes of pure white or rich purple; vessels of brass, silver, and gold, wrought by

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their own skilled artisans; ornaments of carved ivory; emeralds, coral, agate, and amber; and other stores yielded by bountiful Nature or devised by clever man.

These Phoenicians (the Canaanites or Sidonians of the Bible) belonged to the Semitic race. Their country was a narrow strip of the Syrian coast about 200 miles long and about 20 miles wide. It was a land of meadows and pastures, of orchards and vineyards, but so scanty that the Phoenicians were fairly pushed off to sea for a living. Surpassing their teachers the Egyptians, they became the most skilful shipbuilders and navigators of their time. They passed through the Strait of Gibraltar, worked the silver mines of Spain, founded the city of Cadiz on the western coast, sailed as far as the British Isles in quest of tin. and are said to have even sailed around the southern point of Africa. They founded many colonies, the greatest being Carthage, which grew into a great empire and rival of Rome (see Carthage).

The Phoenicians began to develop as a great seafaring, manufacturing, and trading nation when the Cretans—the first masters of the Mediterranean—were overthrown by the Greeks (see Aegean Civilization). Not only did they take the fine wares of the Eastern nations to the Western barbarians, but they became skilled in making such wares themselves—especially metalwork, glass, and cloth. From a shellfish, the murex, they obtained a crimson dye, called Tyrian purple. This was so costly that only kings and rich nobles could afford garments dyed with it, and purple became the symbol of kingly rank and great wealth.

But their most useful service was spreading the alphabet. The alphabet had apparently been invented by another Semitic people (see Alphabet); but Phoenician traders, who used it to keep their accounts, played an important part in carrying it to the other peoples of the Mediterranean.

Thus the Phoenicians were "missionaries of civilization," bringing the arts and culture of the Orient to the still half-barbarous Western World.

The Wealth of Tyre and Sidon

There were two great cities of Phoenicia—Sidon the center of the glass industry, and Tyre the center of the purple industry. In the middle of the 10th century B.C. Tyre assumed the leadership of all Phoenicia. Friendly relations were established with the Hebrews, and King Solomon sent to King Hiram of Tyre not only for materials but for skilled workmen to build the temple, for there were none with "skill to hew timber like unto the Sidonians."

In the 6th century the Phoenicians supplied the great fleets with which Darius and Xerxes attacked Greece. For the most part they submitted readily to their foreign masters and were allowed to retain a certain degree of independence and pursue their commercial ambitions undisturbed. Alexander the Great in 332 B.c. took Tyre, after one of the greatest sieges of history. In 64 B.c. Phoenicia came under the control of the Romans, and under their rule the native language and institutions soon became extinct.

The Phoenician religion was a form of Nature worship; their chief divinities were the god Baal and the goddess Astarte, or Astoreth. In times of great distress human sacrifices were offered to the god Moloch. Many of their religious practices were barbarous and degrading.

Today the small island on which the 25,000 inhabitants of Tyre once crowded into lofty many-storied houses is connected with the mainland by a broad tongue of land, which has grown out of the mole built during Alexander's siege; and the site is occupied by an unimportant town of 5,000 (Sur). Luxuriant fruit gardens cover the place where Sidon once stood, furnishing the main support of the 15,000 inhabitants of the modern city of Saida.

PHONOGRAPH. Of all things sound is one of the most fleeting. Fragile ferns and mosses, perishing before there was an eye to behold them, have left imprints for after-ages to wonder over; but of the singers and orators of past generations who thrilled vast audiences, every tone was irretrievably lost as soon as uttered. What would we not give for a miracle which would enable us to hear Homer chanting the fall of Troy, or Demosthenes hurling invective against Philip of Macedon, or even the loved lost voices of former days?

The miracle which enables future generations to hear the music, the speech, the very tones and accent of today was worked out by an American in 1877. Sound is produced by vibrations of the air, and the changing form of these vibrations can be traced, recorded, and reproduced. (See Sound.) When this discovery was made, the miracle of the phonograph was as good as performed. Thomas A. Edison was not the first man to draw this very obvious deduction, but he was the first to provide a commercially practical means for recording and reproducing the vibrations of sound. Such instruments are variously called "phonographs," "gramophones," "graphophones," or simply "talking machines."

The basic principle of Edison's invention is the same as that employed in the transmitter and receiver of the telephone. When sound waves strike against a very thin flexible disk, called a diaphragm, they cause it to vibrate. If the process is reversed, and a diaphragm is made to vibrate by some mechanical means, it will in turn cause vibrations in the air which will affect the ear as sound.

In order to record sound, Edison attached a cutting needle to the center of a diaphragm and allowed it to rest against a cylinder covered with tin-foil. This cylinder he kept revolving rapidly, and also slowly advancing endways, so that the needle described a spiral path around it.

When this apparatus was set in motion, and sound was directed against the diaphragm, the needle dug into the tin-foil along its spiral path. Thus the cylinder was made to record the movements of the diaphragm. If the spiral groove on such a record be examined under a magnifying glass, it will appear as

MID TO THE TOLLY

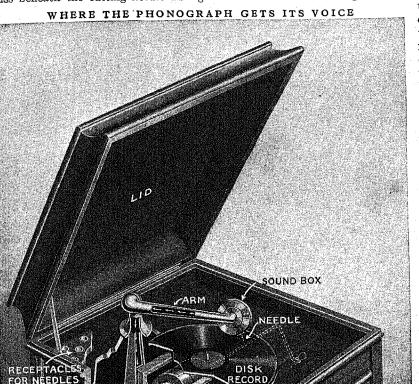
a succession of humps and hollows, so close together that while the cylinder is turning several hundred pass beneath the cutting needle during one second.

MECHANISM

In order to reproduce the original sound the process was reversed. The cylinder was set turning, with the needle resting in the groove. The needle dropped into

the hollows and was driven outward by the humps; and this motion was communicated to the diaphragm, causing it to give off vibrations similar to those of the original sounds. In other words, Edison's machine now "gave out" the same sounds which had before been "put in," playing the part, one might say, first of the human ear, then of the

The phonograph of today is essentially the same as this early instrument of Edison, though many improvements were necessary before it reached its present pitch of perfection. most important of the early developments was the substitution of a wax cylinder for the cylinder covered with tin-foil, which after a few repetitions became so worn as to be useless. Later the wax cylinder was replaced for most purposes by the disk type of record, on which the needle vibrates from side to side instead of up and down. This has several great advantages. The disks are more durable, they take less room to store, and they can take records on both sides. Next, the driving mechanism is simplified, since a single turntable movement is all that is necessary, while the cylinder type requires additional mechanism to give it the slow endwise motion. And finally, the multiplication of records for sale is made much easier. Only a single record, of course, is made direct from the singer's voice or the orchestra, and it is more precious than gold. To reproduce this the original or "master" record is dusted with graphite and electroplated (see



URN TABLE

ARTING LEVER

This "shadow picture" shows a phonograph with a cabinet and other details cut away so you can get a good view of the mechanism. Follow the arrows leading out of the sound box on the arm get a good view of the mechanism. Follow the arrows leading out of the sound box on the arm and you can trace the complicated course taken by the sound waves through the "folded" horn used in the new type of machine.



Electroplating). In this electrotyped copy, called a "master," the groove of the wax original is represented by a raised ridge, and every feature of the wax record is reversed. Another electroplated disk is made from the master, and the second reversal makes this plate, called the "original," an exact duplicate of the master. From the original, molds called "stampers" are taken, and these are used to impress disks for sale. The master and original are carefully stored, for if they were injured, no more records could be made unless the performance were repeated.

Secrets of Record Making

The material from which records are made varies with different companies, but all of them jealously guard the secret of the materials they use. Some compositions used are the "synthetic plastics"derivatives of coal-tar—as well as lampblack, a "flock" made from rags, certain mineral earths, abrasives for wearing the needle to fit the groove, and shellac, vulcanite, hard rubber, and synthetic resins. The best records contain a large proportion of shellac.

Unbreakable records are made of celluloid or a cellulose compound; the new "Durium" process coats a tough paper disk with a special lacquer. This gives a light, flexible record, which withstands handling without injury. The needle, pressing in the groove with a pressure of about 50,000 pounds per square inch, spreads the side walls of the groove, which spring back after the needle has passed.

A new development in recording is the "microgroove" process, in which the grooves are so closely spaced that the playing time of the record is practically doubled. A 10-inch disk, for example, will play for about five minutes, the 12-inch size having a

corresponding increase.

How Radio Hurt, Then Helped

Radio had made such inroads into the phonograph business that it was only revived in 1926 by the adoption of principles developed by electrical and radio engineers, working with acoustical experts. The previous range of two or three octaves for satisfactory reproduction was not enough to record correctly the delicate overtones and nuances which give voice and music its quality, or "timbre." By using electrical apparatus the engineers were able to increase the scope of satisfactory reproduction to cover virtually the whole range of speech and music. For the first time it became possible to secure satisfactory records of the piano and pipe organ.

The reproducer and horn of the phonograph also were greatly improved. The glass or mica diaphragm gave way to one of duralumin, and the horn was replaced by one of the "exponential" type so designed as to allow proper travel and expansion of the sound waves. The 6-foot horn of this type may fit in a small cabinet, as it can be folded back upon itself as

shown in the accompanying picture.

Another type of phonograph makes use of a delicate electrical current generated by an armature moving inside a coil, the armature getting its movement from the needle as it moves back and forth in the groove. This current, feeble though it may be, carries every characteristic of the sound. It is sent through a vacuum tube amplifier and played by the usual speaker (see Radio; Vacuum Tube). Many radio sets are equipped with motor-driven turntables and electric "pickups" so that they may play records or radio at the flip of a switch. Automatic phonographs, capable of playing a long series of records without attention, permit hearing a long program without the annoyance of changing records. Coin-operated phono-

graphs are common.

Millions who will never hear any of the world's greatest singers at first hand have been thrilled by their artistry through the phonograph. Blind students, scholars, and music students find these machines of great value. Records of vanishing races and their songs have been made. The voices of many distinguished persons are being preserved in museums and in the vaults of the manufacturing companies. Whole radio programs are sometimes sent to smaller stations on large records; some talking moving pictures use records to reproduce sound. Equipment for making records at home from radio or other sources is on the market. The dictaphone applies the phonograph principle to the uses of commercial correspondence (see Dictaphone).

PHOSPHORESCENCE (fos-for-es'ens) AND LUMI-NESCENCE. Is there any similarity between the flash of a firefly in the summer night and the glow of a luminous watch in the dark? Many minerals, especially the sulphides of calcium, strontium, and barium, shine in the dark, but they do so because they have been previously exposed to light. Living creatures also generate light, but in a way that is quite different. Phosphorescence, in its strict sense, applies only to the property possessed by some substances of continuing to shine in the dark, without sensible heat, after exposure to

light or other forms of radiation.

The light of living organisms is more properly called luminescence or bio-luminescence. It is not produced by phosphorus, which is a very poisonous element. In the lantern of the firefly there are two substances, luciferin and luciferase. These are manufactured by the cells of the animal. In the presence of air and water, luciferin unites with oxygen and produces light, while luciferase is a sort of enzyme or ferment which starts the process and keeps it going. It is believed that nearly all animal luminescence is produced in this way. In a few cases, as in some cuttlefishes, the light appears to be produced by bacteria localized in little tissue-nests.

Many animals of the ocean are luminous, and the so-called phosphorescence of the sea is due to protozoa which happen to be present in enormous numbers. There are luminous fish, worms, centipedes, insects, and other forms of life. Luminous bacteria cause decaying flesh to emit light, and luminous fungi produce the "fox-fire" of rotting wood. Lumines-

cence is often spoken of as "cold light."

PHOS'PHORUS. Perhaps the most common use of phosphorus is in making the friction matches which enable us to get fire so much more easily than our forefathers (see Matches). At temperatures below 95° F. ordinary phosphorus is an almost colorless or faintly yellow solid substance, having the glistening appearance and consistency of wax. Perhaps its most striking characteristic is that it glows in the dark with a greenish-white light, due to its slow combustion or oxidation. It is so inflammable as to burn by mere friction at ordinary temperatures. Even the warmth of the hand may set it afire, and it must be kept in water lest it may spontaneously burn. In experiments care must be taken or the hands will be severely burned as melted, flaming phosphorus sticks closely.

Phosphorus shines in the dark, from the slow combustion it undergoes. Taken internally, it is a powerful irritant poison; emetics should be given at once, and a dilute solution of copper sulphate. The fumes, too, are poisonous, and workers in the match industry used to be subject to a terrible disease ("phossy jaw") which rots the teeth and jawbone away. This hazard has now been overcome by the use of the non-poisonous sesquisulphide of phosphorus, which is formed by slowly heating phosphorus and sulphur.

Red Phosphorus an Allotrope

Red phosphorus is one of the allotropic forms (see Chemistry) of the pure element, with very different physical properties. It is non-poisonous, and much less volatile and active. It must be heated to 240° C. (464° F.) before it catches fire, while white phosphorus ignites at 35° C. (95° F.). It is prepared by heating white phosphorus in closed retorts.

Phosphorus, being one of those brisk sociable elements, never found uncombined in nature, was not discovered until 1669. It was found by an alchemist named Brand, searching for the philosopher's stone. It occurs in combination in the mineral apatite and other rocks, in guano, and in bones, muscles,

nerves, brain, and other body substance—for, poisonous though the element is, its compounds are necessary to life and are an essential constituent of all fertile soils (see Fertilizers). Egg-yolks and beans are foods containing a large phosphorus supply.

Commercial phosphorus is obtained from bones and "phosphate rocks" formed from fossil bones. Large deposits of these phosphates are found in Florida, Georgia, the Carolinas, and other states. The old process of treating the ash from burned bones or rock

with sulphuric acid to break up the calcium phosphate is being replaced by a process of direct reduction in either an electric or a blast furnace. Carbon, sand, and phosphate are mixed and heated; calcium silicate is drawn off as slag, while the phosphorus vapors pass off into a condenser.

PHOTOELECTRIC DEVICES. The underlying principle of the photoelectric cell was discovered in 1888, by W. Hallwachs, who found that a zinc plate if negatively charged lost its charge when exposed to ultra-violet rays.

This photoelectric effect or emission of electrons when exposed to light, is a property of metals and some other substances. Some of the metallic elements, particularly those of the alkaline metal group, lithium, sodium, potassium, rubidium, and cesium, have been

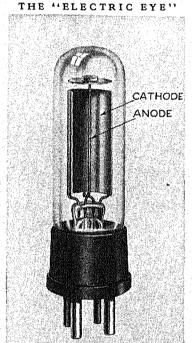
found especially sensitive in photoelectric effects, and are used in the construction of the photoelectric cell or *photocell*, one type of which is shown in the accompanying illustration.

As the picture shows, the cathode consists of a curved plate. On its concave surface is coated the sensitive material, which emits electrons whenever struck by light. Adjoining the terminal is an anode. and a battery is usually connected so as to place a negative charge on the cathode and a positive one on the anode (see Electronics) and to provide an external circuit between the anode and the cathode. These charges aid the emitted electrons in collecting on the anode, from which they traverse the battery source. thus sending a change in current. strictly proportional to the amount of light striking the cell, through the external circuit. It seems that the intensity of the impinging light regulates the number of electrons emitted from the material, while the frequency of the light determines the speed with which the electrons fly forth.

The modern photocell is generally a vacuum tube, although sometimes tubes containing inert gases

are used. Sometimes the cathode of sensitive material, instead of being a plate, is made by silvering the inner wall of the tube and depositing upon it a microscopically thin coating of the element used, leaving a small opening or window of clear glass for the admission of light. There are other types of photoelectric cells, such as that which is operated by exposing to light one of two plates of dissimilar metals in a solution.

Since the element selenium changes its ability to conduct electricity according to the amount of light



This is a photoelectric cell widely used in talking pictures. Construction of the elements is clearly shown. Although fitted to the standard four-prong tube base, two of the prongs are idle, since terminals for only one current are needed. In other types of cell the light-sensitive material is coated directly on the glass.

to run a device, it

usually is amplified

in a circuit contain-

ing vacuum tubes and

transformers, as in a

radio set (see Radio).

Photographic expo-

sure meters, however, use the cell current

without amplifica-

tion. Amplified cur-

rent from a photocell retains all the char-

acteristics of the feeble

current produced by

falling upon it, cells using selenium found considerable use before the photoelectric cell was developed (see Selenium). The two operate on fundamentally different principles, however, since the action of light on the photocell liberates electrons, while in the selenium cell it alters the electrical resistance of the

metal. The photoelectric cell is generally more useful, because its reactions remain constant, while the reaction of the selenium cell changes during continued exposure to light.

Making Cells for Different Purposes

Part of the photocell's usefulness comes from the fact that its sensitivity can be altered to fit different needs. Thus, the vac-

uum type is most sensitive at battery voltages of about 100 volts and higher. The gas-filled types are several times more sensitive, because the electrons ionize gas molecules, and these, as well as the electrons themselves, enter into formation of the current between the cathode and the anode. The gas-filled types, however, are more complex in their reactions, since these change as the voltage applied and the gas pressure

vary. Also, when about 160 volts or more are applied, this is sufficient to ionize some particles, and some current crosses the gap, regardless of whether light is striking the cell, producing a "glow discharge." By choosing among these available reactions, engineers can produce photocells especially suited to

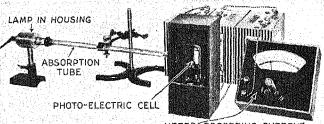
particular tasks.

Another factor to be considered in designing a photoelectric cell is the fact that the various metals used for the sensitive element vary in response according to the wave-lengths, or colors, of light striking them (see Light; Spectrum and Spectroscope). Most of the metals are more sensitive to blue rays than to those at the other end of the spectrum. Cesium is responsive in about the same way as the human eye, which is most sensitive to light at 5,500 Angstrom units (a yellowish-green color). The eye, however, retains more sensitivity as the color changes toward the red tones than when the shift is toward the blue, whereas cesium's response is just the opposite. In color work, therefore, the proper substance must be chosen for the sensitive element, and the light may

be corrected by color filters, according to the nature of the work in hand and the results desired.

The photocell is so extremely sensitive to minute changes in light intensity that it will record the waxing and waning of stars of the sixth magnitude. The current flow from the cell is also small, and before used

THE PHOTOELECTRIC CELL AS A METER



METER RECORDING CURRENT PROPORTIONAL TO LIGHT

This picture shows how a photoelectric cell is often used as a device for measuring the transparency or color of liquids. Light from a bright source at the left passes through a tube containing the liquid to be tested, and into a light-tight box holding the photoelectric cell. The intensity of the light after passing through the liquid is thus indicated by the meter connected in the circuit of the cell.

the emitted electrons in the photocell. This amplified current is then utilized to actuate a device of

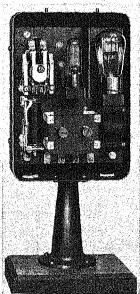
some sort, such as a relay or other mechanism. For example, a device to turn electric lights on and off with the approach of night and day would consist of a photocell placed where natural light would fall upon it, an amplifying circuit, and a relay mechanism to operate a switch. When the daylight falling on the photocell decreased in intensity to a certain pre-

determined point, the lessened current flowing from the photoelectric cell would actuate the relay, closing the switch, thus turning on the lights. When it becomes daylight again, the rise in current emitted by the photocell would again actuate the relay, opening the switch and so turning off the lights.

Hundreds of applications of this simple mechanism are possible. Objects passing a point may be counted by the interruption of the light shining across their path into a photocell; mechanisms can be actuated to throw off a conveyor unlabeled or defective articles, owing to the variation of the light reflected from them as compared with perfect ones; races may be timed with split-second accuracy; shadows of intruders will ring burglar alarms; the failure of a pilot light will shut off fuel supplies to oil or gas-burning furnaces.

Another group of photoelectric devices makes use of the current variation by recording it upon a sensitive galvanometer. Colors of liquids, textiles, or anything else, can thus be scaled and held to a standard much finer than any attainable by the human eye. Such

A LAMP LIGHTER



This unit contains a photocell, a vacuum tube amplifier, and a relay switch. It is used to control signs, factory lights, street lights, or the like. Daylight acting on the cell holds the switch open, but when it gets dark the switch closes and turns on the lights. turns on the lights.

devices are used to measure the transparency of gasoline, to test the colors of oils or dyes, the purity of vinegar, and in many other industrial processes.

The glow-lamp, which depends upon the ionization of gases before mentioned for its illumination (see Electrochemistry), has been developed with the photocell, and the two of them make television practical. Just as the photocell translates varying light into fluctuating electric current, so the glow-lamp can translate a fluctuating current of electricity into a light of varying intensity. Lamps have been developed which will attain full power of light and drop to no light whatever scores of thousands of times per second. This light will vary as the current varies.

Thus the fluctuating current produced by a photoelectric device can be broadcast on a wave-band, just as sound is broadcast (see Radio; Television and Telephotography), received and amplified, and passed to a glow-lamp which will vary its light exactly in keeping with the fluctuating light striking the photocell at the transmitting end.

In the projection of talking pictures, a small projector throws a light through the sound track at the edge of the film. This sound track is made up of continuous light and dark lines of different lengths, which vary the intensity of the light passing through to the photocell. The photocell translates this light into an electric current of varying strength. This feeble current is then amplified and converted into sound.

Photoelectric cells can be made that are sensitive to radiation invisible to the human eye, such as ultraviolet rays. For this purpose substances such as magnesium and cadmium are used for the cathode, and the tubes are made of quartz or special glass.

The MECHANICAL EYE that SEES FOR ALL



PHOTOG'RAPHY. Nature usually performs her tasks much better than any machine, but in the matter of vision the "mechanical eye" invented by man in most ways far surpasses nature's best efforts.

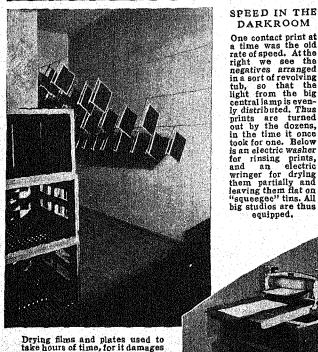
The photographic camera can "see" stars that are invisible to the human eye even through the most powerful telescope. It can catch a glimpse of a bullet as it whizzes through the air. In one three-thousandth of a second it can seize and set down all the countless details of a great crowd on a bathing beach. It can give you a large picture of the tiniest microbe, and a tiny picture of the Pyramids of Egypt.

Besides, by the processes of photography any number of accurate copies of a picture can be made

and printed in newspapers, magazines, and books. In this way the inhabitants of every part of the world can really see and enjoy the wonders of the world for themselves, no matter how rare or distant these wonders may be.

Photography, or "light writing," to translate the Greek words, has become so common in the last 50 years that most people have stopped wondering about it. But when we think of the amazing power this discovery has put in the hands of the human race, it is easy to understand why it has been called, next to printing, the greatest of all educational factors.

If you consult books of natural history printed 50 or 100 years ago, you will realize what photography



Drying films and plates used to take hours of time, for it damages a negative to print from it while it is wet. Above we see the negatives drying rapidly in a room full of currents of hot air supplied electrically. They are ready for use in a few minutes, instead of hours.

act print at ras the old ed. At the object in arranged of revolving that the mithe big mp is evenued. Thus returned he dozens, me it once one. Below tric washering prints, in electric for drying ritally and rem flat on e" tins. All so are thus pped.

has done to spread knowledge. The animals pictured in those old books all look stiff and unnatural, and some of the rarer creatures would not be recognized at all from the drawings. That was because the scientists and explorers of those days were the only ones who had actually seen these creatures, and these men could draw only very crudely what they saw, or the best draftsman could reproduce only very roughly what the explorer described.

The Camera's Life of Travel and Adventure

Today the camera sees, and sees with absolute accuracy, for everybody. It goes into the heart of Africa, and to the South Pole; it braves the dangers of the battlefield, soars above the clouds, and becomes the unfailing eye of the army air scout. It has even penetrated beneath the surface of the ocean and shown sharks attacking their prey. It unfolds the mysteries of insect and plant life in all their minute and complicated detail.

In its most recent development, photography has set all the wonders of the world in motion before human eyes and has created a new form of drama, but that amazing achievement is a separate story in itself (see Motion Pictures).

What is it then that makes all this possible? It's really a very simple thing, the same thing that makes a carpet fade if the sun shines on it for long. In other words, it is the power of light to cause chemical changes. Scientists call this actinism.

To understand how this works out let's go into a photographic gallery and see what happens between the time the photographer points the camera at a "subject" posing in a chair and the time the photograph is finished.

Getting Inside of a Camera

First, let us get inside and look at the camera itself. It is a boxlike affair, and in front projects a short tube containing the lens or "eye" of the camera (see Camera). Inside this tube also is the shutter, a device which may be opened or closed at will, thus letting in or shutting out the light through the lens. The sides of the camera are equipped with leather bellows like an accordion, so the front and back of the instrument may be moved closer together or farther apart. At the rear is a ground glass "window."

If you watch this ground glass with the photographer, as he opens the shutter and screws the front of the bellows-like camera backward and forward, you will see appear upon it a small image of the subject. This image will be upside down, but it will be perfectly clear.

How is this image made? All objects, you know, reflect or throw back at least a portion of the light that falls upon them. White and the bright colors reflect the most, black and dark colors the least. If it were not for this kind of reflection we could not see the object at all, nor could we distinguish brightness from darkness (see Light).

PUTTING A VIEW ON PAPER-THE HISTORY OF A PHOTOGRAPH

First, we see the photographer preparing to make a picture of the famous Grant Monument in Lincoln Park, Chicago. Second, we see how the image is formed on the ground glass inside the camera. In the third view we see the exposed but undeveloped plate. The fourth stage shows one way of bringing out the image; a "developer" has been poured over the plate. The fifth step is that of "fixing" the image, and results, after washing, in the finished negative. From this is prepared the sixth and last stage, the finished photograph.

2. WHAT THAPPENS INSIDE THE CAMERA

Focusing cloth shuts off outside light so the photographer can see clearly the focused image on the ground glass

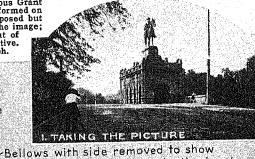


plate replaces Light rays nd glass enter

the lens

how the lens inverts the Image

Focusing screw

4 DEVELOPING THE NEGATIVE

3 THE UNDEVELOPED NEGATIVE

e image is there, but you can't ee it

chemicals bringing out the "latent" ima@e

5. THE FINISHED NEGATIVE

Where white is black and black is white

Now the lens of the camera, like the human eye, collects reflected rays of light from every part of the object in front of it, and after criss-crossing them brings them all together again in their proper order, but inverted, forming an image (see Lens). The camera lens will form this image even in the empty air, but in that

case it cannot be seen until something is put in the way to reflect it. If we put the ground glass at the point where the image is formed, so as to catch and hold the light rays, the image becomes visible. But the distance behind the lens at which this image is formed varies with the kind of lens used and also with the dis-

Fading Carpets and Photography

tance of the object itself from the front of the camera. That is why it is necessary to screw the front of the camera back and forth to find the exact point where the image is clear. This is called "focusing."

Now let's go back to our photographer. He has focused the camera properly, and now he closes the

shutter, cutting off the light through the lens. He then brings out a sort of box, which is nearly as broad and long as the back of the camera, but only about threequarters of an inch thick. This is called a plate-holder. It is absolutely light-tight, but has a sliding front that can be pulled out at the proper time, exposing the photographic plate inside. This plateholder is fitted into the back of the camera in such a way that it occupies exactly the same place that the ground glass did

before. The sliding front of the holder is pulled out, and the photographer says,

"Ready."

Up to the time when the photographer says, "Ready," you have seen only the mechanical and optical side of photography. But at this point the chemical side—the

really important side—begins.
Let's stop again, therefore, and find out what's the nature of this wonderful photographic plate, which is the heart of the whole process. With-

out it there could be no such thing as photography. We have seen that photographic action depends on the same principles as the fading of a carpet by the sun. But this fading of a carpet is, as we know, very slow. Now there are certain wonderfully sensitive chemicals which, when light falls upon them, change their nature with the speed of lightning. The most important of these belong to the class known as silver salts, that is, they are combinations of the metal silver with certain other chemicals. The silver salt most often used is silver bromide.

In making photographic plates, therefore, a thin smooth coating of gelatin containing the silver salt is applied to one side of the glass and dried. These plates are then carefully sheltered from the light up to the time of making the exposure, as the process of opening the shutter and taking a picture is called.

That time has now come. The photographer has said, "Ready"; the sitter tries to look natural; there's a faint click as the shutter opens and closes; and the miracle has been accomplished.

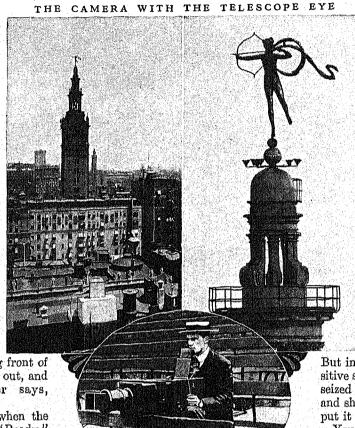
Here's what happened during the fraction of a second that click lasted: The light rays reflected from the sitter flashed through the lens: for an instant they formed on the coated surface of the plate the same image you saw before on the ground glass: then the light flashed off again.

But in that instant the sensitive silver salt on the plate seized every detail of light and shade in that image and put it on record.

You shall now see what a good "memory" a photographic plate has. Closing the sliding front of the plateholder, the photographer takes it out and goes into the darkroom. This is a room lighted only with dim orange or red lights, which are the safety lights of photography. As he removes the plate from

the holder, you feel that something must have gone wrong. There's nothing on the plate but a blank yellow coating. But wait! He puts it in a tray and pours a liquid over it. In a minute or so you see dark patches appear, then some lighter patches, and soon the outlines of a human face. Presently he washes the plate in running water and puts it in another tray full of liquid. Some minutes later he takes it out, turns on a bright light, and examines it.

Well, this is the queerest picture you ever saw. Everything is backward. All the white places, like



The two upper pictures were taken from exactly the same spot and with the same camera. But see the difference! The one at the left was made with an ordinary lens, and you can barely distinguish the statue on top of the tower. But in making the one at the right a "telescopic" lens was put in place of the ordinary lens. In the picture below we see a type of telescopic camera often used for getting pictures of races and other athletic events.

The camera (3) on the

LINE OF FLIGHT

MAKING MAPS BY CAMERA FROM THE SKY

POINTS OF EXPOSURES



Aerial photography serves a multitude of uses. In picture 1 a photographer and his pilot are about to take off to obtain "oblique" views. Such pictures are widely used as illustrations. Maps, too, are often made by piecing together oblique views. Much of Canada has been charted in this way.

right is arranged to take vertical views through an opening in the bottom of a plane. The shutter is tripped automatically at just the right time for the proper overlap,

Most maps are made by taking many overlapping "verticals" like picture 4. The lines drawn on the oblique view above show how a series of verticals is taken so that they overlap each other, thus insuring that nothing is missed.

Now look at picture 4, at the left. This is a vertical "shot" taken from a height of more than a mile and a half. See how clearly buildings, fields, roads, and trees stand out. Most maps are "flown" at about 12,000 feet. When a series of views taken by the method shown in 2 is pasted together, a map results which may compare favorably with ordinary survey methods.

In picture 5 we see soldiers pasting many separate air pictures into a map. Such a map can be made in as little as two hours after the photographs have been taken.

chemical bath, the fixing solut dium thiosulphate, called "hypo" rs). This dissolved away all the

the face and collar and hands, are black and dense, and all the dark places, like the eyes and maybe the clothes, look white and transparent. That's because this is only the negative—the first step in getting the finished picture.

While the negative is being washed and dried, let's see what happened to the plate in the dark-room during those last few minutes. First, you must think of the silver salt on the plate as a chemical compound in which the silver held its companion, the bromine, a prisoner. When the rays of light through the lens struck the plate they loosened the hold of the silver upon the bromine, and wherever the brightest rays struck, this hold was loosened the most. But the bromine could not escape without the assistance of another chemical called the developer. As soon as this was poured on, all the bromine that could possibly get away fled to its new friend, leaving the silver stuck in the gelatin coating.

In some places nearly all the bromine escaped, in others less, and so on down to the darkest parts of the image, where scarcely any was released. This, of course, left a good deal of the original silver salt still on the plate, ready for any stray ray of light to set it free and spoil everything. So the plate was

put in another chemical bath, the fixing solution (composed of sodium thiosulphate, called "hypo" by all photographers). This dissolved away all the remaining silver salts, producing the finished negative, which is now no longer sensitive to light, since all the details in it are composed of pure metallic silver imbedded in the gelatin—the greatest amount of silver being in the places that received the brightest light, such as hands, face, etc.

The photographer now takes the dried plate back into the dark-room and puts it into a device that looks like a picture frame, which opens in the back. Behind the plate he then adjusts a piece of paper of the same size, and closes the frame. He turns on a bright electric light, exposes the frame in front of it for a few seconds, then takes out the paper, and puts it in a tray with another developing solution. In a few moments the real picture appears, with all the lights and shades in their proper places. This is then dropped in the fixing solution for several minutes, washed thoroughly in water, and dried. The photograph is complete and ready for mounting.

These operations, known as printing, are much the same as the processes used to make the negative. The paper behind the negative was coated with a sen-

"CAUGHT" IN MID-AIR -A MARVEL OF SPEED PHOTOGRAPHY



One of the most amazing things about modern photographic plates and films is the quickness with which they can "catch" a picture. The flash of the image for a thousandth of a second or even less is enough on a bright day to impress the sensitive chemicals. This makes possible pictures like the one you see here—a diver snapped in the midst of his downward plunge.

sitive silver salt, similar to that used on plates, but much less rapid in action. The light struck through the transparent places on the negative, turning the paper beneath them dark, but was stopped by the dark places, leaving the paper white. That's how

the face and hands got white again and the clothes returned to their proper dark shading.

There is, of course, endless variety in the minor details of photograph-making, such as the use of slow or fast plates, and of countless kinds of printing paper, giving different finishes and different shades of color from light blue to dark brown or sepia. There are also innumerable combinations of chemicals used as developers. But the operations we have followed represent all the fundamental principles of photography, and once these are clearly understood, the other processes can be easily mastered.

The speed with which photographs can be taken, developed. and printed in emergency cases is of immense value to modern newspapers. By also hastening the process of photo-engray-

ing, which prepares the picture for the printing press, papers containing photographs of some great event are often sold on the street an hour after the event took place.

which may be concealed in the palm of the hand and which take pictures one inch by three-quarters of an inch in size, to the huge and intricate apparatus used

Cameras vary in size from the tiny instruments

in photographing the distant stars.

IN THE SHADOWS OF THE SEA

Here the camera has caught a diver at work in shallow water. One of the greatest obstacles to submarine photography is the darkness which prevails when the greater depths are reached.

The most popular are the film cameras, either of the "box" variety or of the folding type, which closes up like a book. The film, which takes the place of the plate, is simply a long strip of transparent celluloid, coated with the sensitive silver salts. This is wound on a spool, beneath a backing of darkcolored paper which shuts out all the light. The film "cartridge,"as it is called, may be loaded in the camera by day light, and a simple winding device draws it across the back of the camera, exposing one section of the film after another behind the lens.

Film cameras cannot, of course, be focused through a ground glass at the back, so they are made either of the small "fixed focus" variety, which require no adjustment, or they have a focusing scale

which indicates how the bellows should be extended for different distances. They also have a tiny apparatus called the view-finder, which shows you by a mirror reflection the exact view the camera covers. A type of camera in wide favor uses a "film pack" containing twelve flexible films arranged so that pulling a paper tab after each exposure uncovers a fresh film ready for use. The special adapter used, like a plate holder, can be removed to permit focusing on a ground glass.

Modern photographic lenses range from the simple kind used in box cameras to the highly corrected and expensive lenses used for the most exacting work by photoengravers (see Engraving), commercial photographers, scientists, and others. Simple lenses may not be corrected for color errors ("chromatic aberration") or for distortion ("astigmatism") and are consequently not expensive. Neither are they very "fast," because their small diameters or "apertures" do not admit much light. On the other hand, lenses fully corrected for color and distortion comprise the "anastigmat" class, and naturally cost more. The latter are corrected to bring all colors to focus at the same plane, and they will give a sharp, undistorted image over the whole plate. They are usually made with larger apertures, admitting more light in any given time.

What "f/8" and "f/6.3" Mean on Lenses

In the United States, the relative apertures of photographic lenses are usually expressed in the "f system," in which the ratio of the aperture to the focal length of the lens is given thus: f/8, or f/6.3, or the like. This means that the widest opening of the f/8 lens is $\frac{1}{8}$ of its focal length when focused on a distant object. No matter what the focal length of a lens may be, if it is an f/8 lens, it will have the same speed as any lens of the same relative opening.

Most lenses except the very simplest have an "iris diaphragm" to make a larger or smaller opening. This diaphragm is controlled by a ring or pointer, which travels over a scale giving the size of the openings, or "stops." Each successive stop has $\frac{1}{2}$ the area of the preceding stop, hence requires twice the exposure, except in special cases. So it is easy to determine what the exposure should be with a certain stop, if the correct exposure for any one stop is known. Many folding cameras are equipped with lenses of f/8 aperture, or f/7.9 or f/7.7. For all practical purposes the latter two may be considered as f/8.

Relation of Time and Aperture Used

The faster a photographic lens, the more care is required in getting a sharp focus. When any lens is focused on an object of medium distance, the image of objects both nearer and farther than the principal one will be fairly sharp also. This ability of a lens to give a reasonably sharp image in more than one plane is its "depth of focus." On any lens, a focusing point will be found, where all objects beyond the principal object will be in sharp focus. The distance to this object is called the "infinity point" of the lens. Opening the lens diaphragm wider reduces depth of focus and shortens the infinity distance.

For the reason just given, it is necessary to use care in focusing fast lenses, since they have little depth of focus. Also, for this same reason, one should always employ the smallest stop consistent with the necessary time of exposure. Small apertures require longer exposures, but the depth and general sharpness of the pictures are greatly enhanced. This should show the error of using a fast lens "wide open" all the time, a frequent mistake of beginners.

Lenses are on the market having a relative aperture of f/0.99, which simply means that the lens opening is greater than the focal length. Some idea of the light-gathering power of this lens may be had when we consider that the average human eye works at an aperture of about f/4. The "candid camera" uses a lens of very large aperture—f/2.9 or larger—for snapshots indoors with the ordinary illumination.

"Telephoto" lenses are those which give an image of an object several times larger than an ordinary lens of conventional design, but which require no longer bellows. In other words, a telephoto unit of 6-inch focus magnifying 4 times will give an image just 4 times higher and wider than that given by a normal 6-inch lens. First brought into prominence through their ability to give large images of distant objects, it has been found that these lenses fill a need for equipment giving better perspective in many classes of work, not necessarily pictures of distant objects (see Drawing). The use of such lenses in "telephotography" should not be confused with the transmission of pictures and facsimiles by wire or radio, often called by the same term (see Television).

Orthochromatic and Panchromatic Films

Ordinary "orthochromatic" films and plates are not sensitive to red and orange, but give fairly good renditions of the other rays. Other emulsions, sensitive to all the colors in various degrees, are the "panchromatic" forms, so named from the Greek words meaning "all colors." The ability of panchromatic film to register red and the other rays in that portion of the spectrum (see Light) is strikingly demonstrated by the employment of the infra-red rays in certain forms of photography. Although invisible these rays will affect panchromatic emulsion; hence it is possible to take pictures in rooms which appear totally dark, provided infra-red rays in sufficient amount are present. Some use of this phenomenon has been made in aerial photography, for penetrating camouflage and extremely heavy haze.

Panchromatic emulsions must not be handled in the dark-room by red light, of course. It is possible to use a very faint green light, but it is impossible properly to judge development, so that the "time and temperature" method is resorted to. Development proceeds for a definite time depending on the temperature of the solution. Or "desensitizers" such as pinacryptol green (a dye) may be used. After a few moments' immersion in a developer containing such a desensitizer, a yellow light may be turned on, thus permitting development to be done by visual control.

The fastest or most sensitive films formerly gave coarse-grained negatives, from which great enlargements could not be satisfactorily made. The discovery M& CHARLES PHYSICAL TRAINING

of how to make fast films with fine grain from which enormous enlargements are possible, is one of the most important recent developments in photography. It brought about the widespread use of miniature cameras using ultra-rapid lenses and tiny film rolls.

Another far-reaching result is that whole newspapers, long documents, and books can be photographed and printed on small rolls of positive motion picture film at slight expense. These micro-copies can be stored in much less space than the originals, and can be clearly projected on a reading screen whenever desired.

A valuable contribution to indoor photography is the photoflash lamp, which has replaced flash powder. This can be used with battery or house current. It contains aluminum alloy foil, which flashes brilliantly without noise or smoke.

Hints for Beginners

A few simple rules will help the serious beginner. They are these: (1) Focus carefully. It is no disgrace to measure short distances with a tapeline; professional Hollywood cameramen do it. (2) Give the proper exposure. Use an exposure guide or exposure meter, if possible. (3) Stop down the lens when possible. It will make your pictures sharper. Give longer exposure to compensate for this. (4) Give thought to the arrangement of the picture. Artistic composition creates more fine photographs than expensive equipment.

Color Photography

Direct-color photography as described on the back of the adjoining color plate is beyond the reach of the beginner. But it is easy to work with the modern color films which can be projected on a screen or viewed directly by holding them up to the light. The best known of these is kodachrome film. This is coated with three layers, and special dyes make each layer sensitive to only one group of colors—the top layer to the blues, the middle layer to the greens, and the bottom layer (next to the cellulose film) to the reds. Exposed in the ordinary way, the film records the different colors in different layers. After development it undergoes a chemical treatment called "reversal" which changes it from a negative to a positive. Each layer now represents the color that is opposite or complementary to the one originally recorded in that layer. Thus the first layer represents yellow, the second magenta, and the third blue green (see Color). By a selective dyeing process, each of the layers is now dyed in one of these colors, and the color combinations from the three layers complete the image. The technique of this method is secret, and so the film must be sent to the manufacturer for treatment.

Architects and others use blue-print paper on which are printed the lines of mechanical drawings or plans. These appear as white lines on a blue ground. The paper, clamped in a frame behind the drawing done in ink on transparent cloth, is exposed to sunlight or to an electric arc, and is developed simply by washing in cold water for five or ten minutes. Equal solutions of ammonia citrate of iron and potassium ferro-cyanide are the sensitizing agents. While not a true photographic process, often pleasing prints may be

secured by printing from ordinary negatives.

PHRENOL'OGY. A little more than a century ago Francis Joseph Gall, a German physician, developed into an elaborate system the theory that the functions of the mind are closely connected with certain areas of the brain. He mapped out the brain into 26 definite regions and taught that each of these is the organ of a definite "faculty" or mental or moral disposition. Gall further believed that the relative development of these organs is manifest in the shape of the skull. Thus, by measuring the skull and charting its "bumps" and depressions, one could discover to what degree an individual possesses the various "faculties," and so read his character. "Phrenology" (from the Greek words phren meaning "mind," and logos meaning "science") was the name given to these teachings. Other writers expanded Gall's system until they had charted 43 so-called "faculties."

For a few years the belief in phrenology had great vogue in Europe and the United States. But today phrenology has fallen into disrepute and is no longer seriously regarded as a legitimate field of scien-

tific knowledge. (See Brain.)

PHYSICAL TRAINING. In pioneer days people maintained their health and strength without a thought of special exercise; but now conditions are changed. Physical training does not attempt to produce trained athletes, for too much exertion is sometimes as dangerous as none; but it does aim to produce and retain normal health for those whose

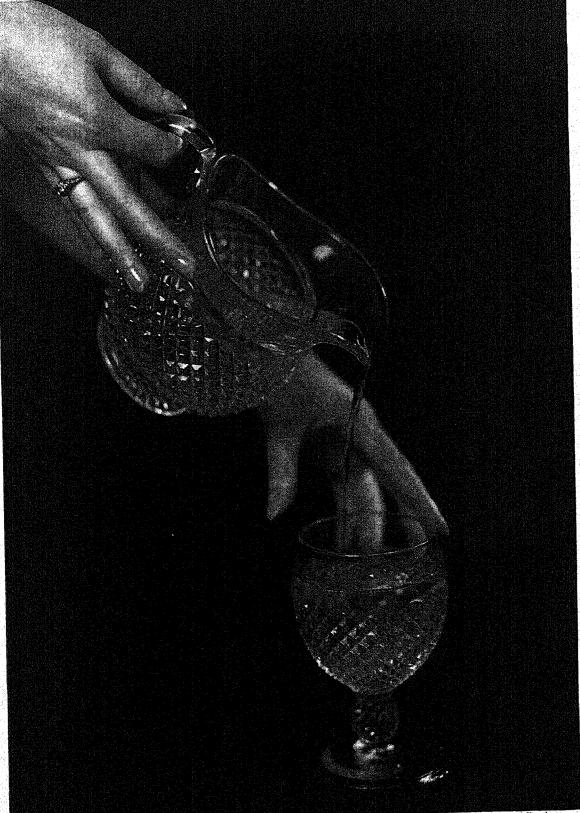
lives are largely sedentary.

Many exercises can be performed anywhere without gymnastic equipment; but pure air is always important. Such exercises should be practiced daily and at regular times if possible, but never within two hours after eating or one-half hour before. The best times are 10 to 12 in the forenoon, or 4 to 6 in the afternoon. Very good results may be obtained by practicing for 15 minutes in the morning before breakfast; and gentle exercises may also be taken with benefit at night before going to bed. Violent exercise at night is likely to cause sleeplessness.

"Gymnastics" differ from such "setting-up exercises" in being performed with the aid of special kinds of apparatus. "Light gymnastics" include such exercises as are performed with light pieces of portable apparatus, such as dumb-bells, Indian clubs, wands, hand rings, and balls. "Heavy gymnastics" include those performed with horizontal and parallel bars, ladders, vaulting horses, suspended ropes, poles, rings, and trapeze bars, where the weight of the body is supported and made to move or revolve about the apparatus by aid of the hands or legs. Work with special apparatus is of particular value to persons who, on the advice of a physician, wish to take some form of "corrective gymnastics."

Better than setting-up exercises and gymnastics, however, are games played in the open air (see Baseball; Football; Golf; Tennis; etc.), and such outdoor sports as running, bicycling, jumping, pole

vaulting, swimming, skating, etc.



Instantaneous direct-color photograph

See text on following page

A TRIUMPH OF COLOR PHOTOGRAPHY

ETHODS for recording color and reproducing it correctly by photographic processes have been vastly improved in recent years. The older method, still employed for "still" subjects, consists in making successive negatives through variously dyed filters, which "separate" the colors into their component parts so that all the blue of a subject, for example, will be recorded on one plate, all the red on another, and all the yellow on a third. From these negatives prints can then be made in the corresponding inks or dyes, which when superimposed one upon the other, reconstruct the colors of the original subject. Such colors as green, for instance, will be reproduced because, in the original color separation, a part of the green was recorded on the blue negative and a part on the yellow negative. When these two come together again in the final print, green reappears.

Far more difficult is the task when the photographer deals with a moving subject, like the one on the preceding page where water is being poured from a pitcher. He cannot make his three negatives, one after the other. They must all be made at once, and in a very short fraction of a

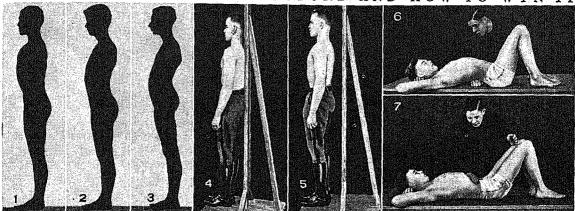
second.

For this purpose ingenious cameras have been invented which divide the light coming through the lens into three beams that come to exact focus through three color filters upon three separate plates at once.

Because of this division of light through a system of semi-transparent mirrors, much of its energy is lost and great difficulty is experienced in equalizing the remainder over the three plates. Powerful illumination and extremely delicate adjustments are required.

The recent development of plates and films that are extremely sensitive to the entire range of colors has done much to help the experimenters with instantaneous color photography and to make more generally practicable pictures like the one shown here.

POINTERS ON CORRECT POSTURE AND HOW TO WINIT



Proper posture is shown in the shadow picture 1 rated A at Culver Military Academy. Poor posture is shown in 2 and 3—head too far forward, chest not up enough, stomach sagging, back swayed. How can one be sure of having proper posture? Stand like the boy in 4, with heels several inches from the wall; buttocks, shoulders, and head against the wall; chin up; and chest in Then shove away from the wall with one hand without changing the position of the body, as shown in 5. In 6 the boy has a sway back so hollow that the instructor can place his fist between it and the table. As a corrective exercise, the boy in 7 lies flat on the table, raises his knees, and pushes his hips down toward his heels.

In recent years a great deal of attention has been given to the study of posture not only for the sake of appearance but for the sake of health and efficiency. Good posture is essential to proper adjustment, physical and mental. Poor posture cramps the vital organs, hastens fatigue, and stores up body poisons.

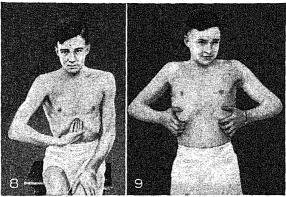
To stand properly and easily you should relax your knee muscles enough to avoid strain and rest the weight of the body

firmly on both feet. The abdominal muscles should be held firm, the chest up (but not enough to cause the lower back to curve greatly), the shoulders relaxed, and the head erect.

In walking, the same general rules for posture hold. One should walk with the toes straight ahead and with the feet flexible in comfortable shoes.

In sitting, one should be well back in the chair, with both feet squarely on the floor. The upper back and neck should not bend; one should bend forward from the hip joints. Sitting without change for a long time is tiring and causes slumping.

Look over a group of people in gymnasium or bathing suits. Note the num-



The boy in 8 has the proper rib spread, with room for heart and lung action. Room for four fingers at the apex where the ribs join is the test. A narrow rib spread may be broadened as in 9 by pulling the ribs outwards while inhaling and keeping the hold while exhaling. Repeat 10 times.



Well back in the chair, back and waist straight, chest up, the youth in 10 is sitting correctly. His feet also are square on the floor.

stiff tense knees, posture defects which are less noticeable but are no less common and serious. Notice too how awkward these same people appear, as compared to the few who know how to carry themselves properly.

Corrective Exercises

Physical training and corrective gymnastics do much to improve faulty posture. Many games played in the open air and such outdoor sports as running, bicycling, jumping, pole-vaulting,

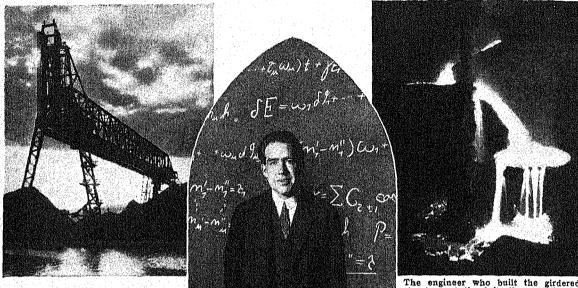
swimming, and skating are also valuable as aids to correct posture.

Most schools give exercises and training in correct posture. The pupil is taught to maintain a good position while standing, while marching, and during exercise. Directions and tests are given to encourage this habit and to point out defects.

Posture defects once firmly established do not yield readily to corrective treatment. Therefore, the essentials to good posture, such as strong bones, firm and well-coordinated muscles. and proper social adjustments need consideration from earliest childhood. A feeling of self-confidence, courage, determination, and good cheer does

ber with flat hollow chests, sagging stomachs, round more to influence poise and excellent carriage than humping shoulders, hollow or sway backs, or droopy do mere mechanical drills. And correct posture will heads. Some of them doubtless have fallen arches and definitely increase a person's feeling of well-being.

The MASTER SCIENCE and Its Chief PRINCIPLES



PHYSICS. The desire to know and master the mechanism of the world is as old as the human race, and the story of how men have tried to satisfy that desire forms a large part of the history of civilization. But we should

illustrate that story falsely if we imagined that primitive people were amazed and confused by the com-

plexity of the world around them.

To savage or primitive minds the ordinary every-day world does not seem complex. That water runs downhill, that sounds travel through the air, that fire is hot, and that different objects have different colors, appears to them perfectly "natural." They do not ask for explanations, because it never occurs to them that those things need to be explained. Only in the face of spectacular or unusual events, like lightning or violent winds or a strange animal or an unfamiliar machine, do they feel "scientific curiosity."

But we need not limit this taking the world for granted to savages. Before the days of Galileo and Newton, thousands of brilliant men had lived their whole lives through without even recognizing that the fall of an apple presented a problem. And today the name of Einstein has grown great in renown because he asked questions in quarters where the famous scientists who preceded him had seen nothing that needed

answering or explaining.

Learning "How To Be Curious"

The science of physics is devoted to raising and defining problems, as well as to answering them. It teaches men, first, how to be curious about the physical world; and second, how to satisfy their curiosity.

The beginner is very much like a man born in a room full of whirring and intricate machinery. He must first get over taking it for granted. He must The engineer who built the girdered structure at the left, the metallurgist who planned the steel-making process at the right, and the professor lecturing a class on the laws of matter and energy in the middle picture—all three are servants of the great science of physics. The professor in this case is the famous Niels Bohr, and the calculations behind him on the blackboard deal with the structure of atoms.

become interested enough to examine it part by part. At first he is conscious only of the multiplicity of moving parts; then he perceives that they are actuated by systems of wheels and levers. Back of these he discovers driving motors; and then he learns that they, too, are moved by a greater power, a dynamo. And beyond that dynamo there are yet other forces to understand—the steam turbine which drives it, and where its power comes from.

In some such way have the physicists proceeded in their efforts to solve the two great questions: first, how is the universe made; and second, how does it operate? For the science of physics deals with matter, and with the fact that matter moves or changes. It

is a basic, fundamental inquiry.

In one sense, the sciences relating to life have been set apart from physics. But in the larger sense physics is the basic science, which examines all, and other sciences are but branches of it. Chemistry, for example, is interested in how matter is constructed, how it is put together, and how it may be taken apart and recombined for man's utility. But physics deals with the basic nature of matter underlying all its chemical forms, with the forces that are derived from it or act upon it, whatever their character.

The Universal Science

Physics treats of motion, light, heat, sound, electricity, magnetism, and other properties and actions of matter, energy, and space—and thus some parts of it must underlie all other sciences. During the past

thirty years the science of physics as formerly conceived has been largely revolutionized. It has been discovered, for example, that matter and electricity are fundamentally the same. A basis for chemistry has been found in the physical interactions of atoms and their parts. Mathematical relationships of profound significance have been discovered.

Thus has come into being the "new physics" which includes radioactivity, the new knowledge of atoms, the Einstein theory of relativity, and so on. This does not mean that the old physics has been discarded. Nor does it mean that physics has become vastly complicated with a multiplicity of discoveries. In fact, the new physics brings us nearer a unified and consistent scientific system. Where several phenomena used to require different unconnected theories to account for them, now a single theory offers a more logical and simpler statement.

The core of the science of physics, new or old, remains the properties of matter and energy. It is with these various properties and aspects of matter, and with the diverse forms of energy that we shall deal.

Forms and Properties of Matter

Matter may exist in three states: as solids, liquids, or gases. Gases maintain neither shape nor volume, but will expand continually if not restrained. Liquids have volume, but not shape, taking on the contour of any container in which they are placed. Solids, though, have both shape and volume.

The molecules of a solid are fixed in position, their motion limited to vibration; those of a liquid are in contact with one another, but are able to slide around like shot in a pan; those of gases are free to move in all directions.

Matter also possesses extension, particularly noticeable in solids. It occupies space. Two pieces of matter cannot occupy the same space at the same time.

Inertia is an important property of matter. It is inertia in matter which resists any attempt to start it when it is at rest, to stop it when in motion, or to change either the amount or direction of its motion. It requires an external force to overcome inertia. We measure inertia by the mass of matter, which should not be confused with weight. Weight is but one aspect of mass, and depends upon the gravitational attraction of the earth for the piece of matter concerned. Weight is simply one arbitrary method, in terms of gravity, by which we compare the masses of different bodies. It may change, but mass, being the quantity of matter in a body does not change. We know, for example, that a lead bullet will weigh a little more at the surface of the earth than it will five miles in the air, for the gravitational attraction is less. If it were possible to

reach them, there are places in space where the bullet would weigh nothing, because the gravitational pull of the earth upon the bullet would be offset by that of other planets and the sun. But the quantity of lead in the bullet—its mass—would be unchanged. Fired from a gun, it would strike with the same force as at the earth's surface.

One of the older principles of physics is that mass cannot be altered. This was called the principle of the conservation of matter. If a lump of coal is burned, this principle asserted that the total mass of gases, ash, and other substances produced is exactly equal to the original mass of coal, plus the mass of oxygen from the air used to burn the coal. In other words, the form of matter might be changed, but matter could not be destroyed, nor could its mass be increased or diminished.

It is now believed that in some cases the principle may not hold. There are some atomic reactions in which matter is believed to be converted into energy. Under ordinary circumstances, however, the principle still holds, as the illustration on this page shows.

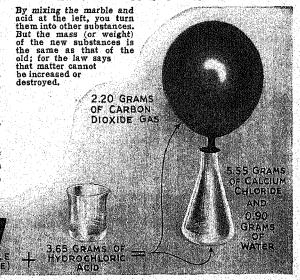
Density and Volume

Density is the ratio between mass and volume, and as we usually consider mass in terms of weight, density becomes the ratio between weight and volume. Volume is the measure of matter's extension in space. A cubic foot of water, for example, weighs about 62.5 pounds at the earth's surface, while a cubic foot of iron weighs 490 pounds. Iron then is said to have a greater density than water in the ratio of 490 to 62.5. Iron has more mass, that is, in the same volume.

Density is often expressed as specific gravity, or the ratio between the mass of the substance and the mass of the same volume of water. The cubic foot of iron weighed 490 pounds as against 62.5 pounds for the same volume of water, or 7.84 times as much. Its specific gravity, therefore, is 7.84.

The specific gravity determines whether a substance will float in water. If its specific gravity is less than 1.00 it will float; if more than 1.00 it will not float in water. Specific gravity of gases is usually expressed

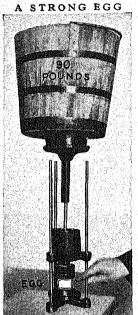
THE LAW OF THE CONSERVATION OF MATTER



in comparison with the weight of an equal volume of air. On this basis the specific gravity of oxygen is approximately 1.11, of carbon dioxide 1.53, of nitrogen 0.97, of hydrogen 0.07, of bromine vapor 5.52.

Cohesion and Adhesion

Solids and liquids also have the property of cohesion, by virtue of which matter holds together. *Cohesion* is the force which binds together molecules



The egg at the bottom holds up the bucket full of sand. Brittle as it seems, an egg will support a large weight if the force is evenly applied at the ends. The arched shape of the shell distributes the stress so perfectly that at no point is it great enough to tear apart the shell's molecules. Some eggs support as much as 150 pounds in this machine.

that are alike. Adhesion is the force which binds together unlike molecules. The graphite in a pencil coheres, while the mark it makes adheres to the paper. The engineer expresses cohesion in terms of compressive strength and tensile strength. Granite has greater compressive strength than wood, because it has greater cohesion. Steel piano wire is harder to pull apart than thread, and so has more tensile strength.

Differences in the cohesive forces between the molecules of substances determine certain other properties which we describe as hardness, tested by scratching; brittleness, tested by breaking; ductility, tested by drawing into wire; and malleability, tested by hammering into thinner form. The atomic and molecular arrangement also may control such properties as plasticity, tested by molding; and viscosity, tested by pouring.

In engineering elasticity is important. It may be defined as the tendency of a body to return to its original shape after being deformed by an outside force. In the language of physics, stress is the force producing such deformation, while strain is the deformation so produced. If a body returns perfectly to its original shape it is said to be perfectly elastic. Elasticity should not be confused with ease of deformation. Rubber is easily deformed, but is not so elastic as steel. That is, stretched rubber does not return so perfectly to its previous shape as does steel.

These properties, which we ordinarily associate only with solids, apply to all matter, theoretically at least. The states in which we ordinarily find matter are determined by temperature and pressure.

Changes in States of Matter

Water, of course, is the commonest example, being easily changed from its ordinary state as a liquid into either a solid or a vapor by changing its temperature.

We know that many metals and minerals may be liquefied by heat; some may be gasified. Liquids may be gasified at high temperatures, and frozen into solids at low ones. Gases, such as air, helium, and others, may be liquefied and even solidified at low temperatures. (See Gas; Liquid Air.)

Some substances are capable of sublimation, which is the change from solid to gaseous form without passing through the liquid stage. Arsenic and iodine, for example, will sublimate. "Dry ice" does not melt in the air but sublimates from the solid cake into carbon dioxide gas, though the gas may be made

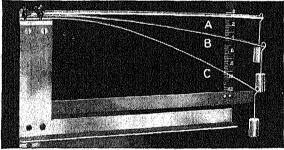
liquid under pressure.

There are states of matter difficult to classify, illustrated by rubber and tar. An old experiment is to remove the bottom of a barrel of solid tar, put a cork there, fasten the bottom on, and leave the barrel with the open head up. In the course of time, it might be weeks or months, depending on the temperature, the cork will come to the top, actually having floated there. The solid tar has the properties of a liquid.

Force and Acceleration

The branch of physics called *mechanics* deals with the motions of matter and the relations of motion to force. Force may be defined as any external action which tends to set matter in motion, or to change any motion which already exists. Force is usually defined and measured by acceleration, which is the rate at which the velocity, or speed, of motion changes. The force of gravity due to the earth, for example, acts upon a falling body in such a way as to cause it to fall

ELASTICITY OF IRON AND ALUMINUM



The three weights are equal. The aluminum bar A is the same weight as the steel bar B; the aluminum bar C is the same size as B. Equality of size is the usual test basis.

approximately 16 feet in the first second, 48 feet in the second second, 80 feet in the third, and so on.

If we leave air resistance out of the calculation, the speed or velocity of the falling body continually increases. The acceleration, that is, the rate at which the velocity increases, is constant, however, and equals about 32 feet per second increase of speed in each second of fall. The whole distance traversed by a falling body in any number of seconds is equal to the distance traversed during the first second multiplied by the square of the number of seconds. This is commonly expressed in the formula, $S = Dt^2$, with D representing the distance traversed the first second, S the total space, and t the number of seconds.

This is a measure of the force of gravity—the only direct measure of that force, in fact, that can be obtained. One of Newton's famous Laws of Motion (see Mechanics) states that the force acting on any body, and the acceleration with which it causes the

body to move, always are proportional to each other. If a force acts to make the motion of a body slower instead of faster, it is said to produce the negative acceleration of that body.

Measuring Forces

For practical purposes it is often inconvenient to measure the acceleration of a body in motion. Accordingly, forces are often measured by comparison with the force of gravity, that is by weighing. Another way is by the stretching of a tested spring, like that of a spring balance. The result of forces exerted along different lines may be computed in accordance with the so-called parallelogram of forces illustrated herewith. Forces are said to be in equilibrium when they exactly balance each other so that no motion is produced. If a pound weight is hung on a spring balance, the force of gravity corresponding to one pound comes to an equilibrium when the upward pull of the spring equals one pound.

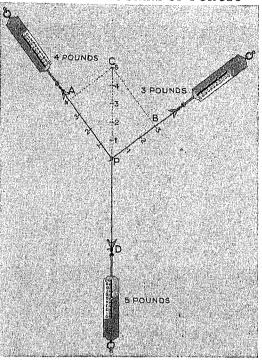
Ideas of motion, acceleration, velocity and so on involve the idea of *time*. The fundamental unit of time in physics is the sec-

ond, defined as 86.400 part of the time taken for one rotation of the earth on its axis. Physical science commonly uses the *C.G.S. system of measurement*, based on the centimeter as the unit of length, the gram as the unit of weight, and the second as the unit of time. (See Metric System; Weights and Measures.)

Important ideas in mechanics are those of inertia, already defined, and momentum. Momentum is the quantity of motion, and is measured by the product of mass and velocity. A one-pound cannon ball, moving 2,000 feet per second, and a 2,000-pound weight moving one foot per second have the same momentum, because the product of the speed and the mass of each is the same figure. Momentum involves the idea of energy, for the cannon ball would not have

had momentum unless energy had been applied originally to move it, and to stop it energy must be applied. Stopping the cannon ball requires that energy be absorbed from the moving ball; for example, by the crushing of the wall against which it hits.

THE PARALLELOGRAM OF FORCES



When three forces are acting in different directions upon a point P, if we know two of the forces and the angle between their directions, we can compute the third by drawing what is called the parallelogram of forces. Suppose, for example, we knot together strings from three spring scales as at P above, and then stretch the scales apart and tack them on a drawing hoard. We read the two upper scales and propose to show how they can be made to reveal the reading on the lower scale. Along the string PB we mark off 3 inches corresponding to the 3-pound force acting on it. Similarly we mark off 4 inches along the string PA to represent the force acting there. We now draw the line AC parallel to PB and the line BC parallel to PA. This completes our parallelogram. Our rule says that the length of its diagonal PC will represent exactly the force acting on the lower string PD. We measure PC, and find, indeed, that it is exactly 5 inches long, corresponding to the 5-pound pull on the lower scale. The units here were chosen for their simplicity, but the method will work for any combination of forces or angles.

Types of Energy

Moving bodies are said to have kinetic energy, or energy of motion. Another form of energy is potential energy, or energy of position. A cannon ball on a shelf, for instance, has potential energy corresponding to its mass and to the distance it will fall if it rolls off the shelf; or, to put it another way, it has a potential energy equal to the amount required to raise it to that position. If it does roll off, this potential energy is transformed, in the act of falling, into kinetic energy. Potential energy may be stored, as in a coiled spring.

Another of the older principles of physics was that of the conservation of energy. According to this principle energy can neither be manufactured nor destroyed, but merely converted into some other form of energy. The energy of a falling object may be converted into heat when the weight hits the floor. Like that of the conservation of matter, this principle is not now thought to hold accurately under all conditions.

Work and Power

In engineering, use is made of two other physical

ideas related to those of force and energy: the ideas of work and power. Work is defined as the product of force and distance. To lift a weight of one pound, one foot high, for example, requires one foot-pound of work. Power is the rate at which work is done, and implies time measurement. If the pound weight is lifted one foot within one second, the power expended was one foot-pound per second. Work and power are often expressed in electrical units. The watt and the kilowatt (1,000 watts) are units of power (see Electricity), that is, of the rate of expenditure of electrical energy. Work, or the capacity for doing work (energy), is expressed electrically in watt-hours or kilowatt-hours; that is, the rate at which energy is expended multiplied by the time of expenditure.



The pound is a unit which varies, being subject to the changes found in the force of gravity at various places. So for an absolute unit of the measurement of force, the dyne is used. A dyne is the force which will give a mass of one gram a change in its velocity of one centimeter in one second. Roughly speaking, in terms of weight, one gram equals 980 dynes, and one pound equals 445,000 dynes.

Kinds of Motion

Two different kinds of motion are taken into account in physics: linear motion, which is motion in a straight line; and rotation which means motion around an axis, like the rotation of a wheel or of the earth. Just as

bodies in linear motion, like the cannon ball, have linear momentum, so bodies in rotary motion have angular momentum, which is the quantity of rotary motion, and is defined as the product of the component of momentum at right angles to the radius, and the radius.

The rotational equivalent of force is called torque. Centrifugal force is not a force which acts on the rotating body, but is the force which the rotating body exerts on whatever makes it stay in its circular path. Imagine, for example, a weight on the end of a string, being whirled around rapidly. According to Newton's First Law of Motion, the weight tends to move off in a straight

line, not to follow the circular motion. There are two forces here, a centrifugal force which tends to break the string, and a restraining force, called the centripetal force, which are balanced in this case.

The Force of Gravity

Gravitation is one of the most important forces to man. Its nature is entirely unknown, except that scientists have observed that all kinds of matter tend to attract each other. Two small metal balls, hung on strings a few inches apart, attract each other and are drawn slightly together. The gravitational attraction between the great mass of the earth and the balls is so much greater than the minute attraction between the two balls that it is difficult to detect the mutual attraction of the balls except by the most delicate scientific apparatus.

The Law of Gravitation, determined by observation, is that the attractive force between any two masses of matter is directly proportional to the product of these masses, and inversely proportional to the square of the distance between their centers. When the force of gravity is the same at all points in a body, as it is almost exactly for a body near the earth's surface, the body acts as though all of its mass were concentrated at a single point, about which its mass is uniformly distributed. This is called the center of gravity—the point at which we consider its whole weight to be concentrated.

One important application of gravitation is the pendulum, like the pendulum of a clock. The chief fact about the pendulum is that the number of swings made per minute is independent of the weight of the pendulum and depends only on the length of the pendulum and the intensity of the force of gravity acting upon it. The same pendulum at the same place always swings at the same rate, which is why they can be used in clocks. Two pendulums of equal length, or

the same pendulum moved from place to place, may be used to measure variations in the intensity of the earth's gravity. (See Pendulum.) In its back-and-forth motion the velocity of the pendulum is at a maximum at the center of each swing, and decreases to zero at the end of the swings.

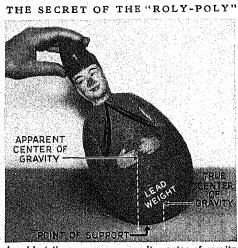
This is an example of periodic motion, or motion which tends to repeat itself continually. Periodic motion, especially a kind called simple har-

monic motion, is very important in theories of sound waves, oscillating radio currents, and other physical phenomena. The motion of the bob of a pendulum, swinging from zero velocity through maximum velocity and back to

zero velocity again is very nearly simple harmonic motion. Likewise, the current wave of an electric generator is a form of harmonic motion.

The Law of Machines

For the practical application of force, energy, work, power, and the like, mankind uses various machines (see Mechanics): notably, the wheel, the lever, the axle, the pulley, the inclined plane, the wedge, and the screw. The law of such machines is that the work done to move the machine is in all cases the same (friction and other losses being ignored) as the amount of work the machine delivers. However, the great difference is that machines make use of the fact that work is the product of force and distance. The force exerted on the machine is not necessarily the force delivered by it. With a lever of unequal arms, for example, the force exerted on the long arm may be one pound through a distance of five feet, while the short arm may move up one foot with a force of five pounds. Both distance and force vary, but the work—the product of force and distance—remains the same. By moving through a shorter distance, the force delivered by the short arm becomes greater than the force applied. Machines, therefore, may be considered



An object tips over as soon as its center of gravity falls "outside" the point of support. If its center of gravity were where it appears to be, this doll would tip over. But the leaden weight in the base brings the center of gravity so low, that it always stays "inside" the point of support.

accounts for the rise

of liquids inside fine

tubes, or in tiny

spaces in a sponge,

often called capillar-

as devices to transform one force into another.

Effect of Friction

In practical problems of mechanics, frictional force is always present. Friction is the resistance experienced by two bodies which rub together. It is often considered an enemy of engineering, but its abolition, were such a thing possible, would he disastrous.

Friction between one's shoe sole and the pavement is necessary in walking. Friction between belt and pulley is necessary for the transmission of power. Friction holds nails in wood and screws in metal. But friction does take an important toll. The power applied to a machine must not only be sufficient to operate the machine but to allow for the additional work used in overcoming friction. To minimize it in machinery oiled surfaces and greased bearings are used.

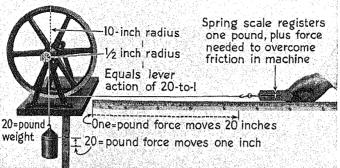
Study of Liquids

The branch of mechanics which deals with liquids is called hydraulics. Since the atoms of a liquid are able to slip easily over each other in any

direction, liquids have the property of flowing. This is why a liquid will transmit hydraulic pressure equally in all directions (see Hydraulic Machinery). Another important principle of hydraulics is the Principle of Archimedes: the buoyant force of a liquid is equal to the weight of liquid which is displaced. For example, a ship sinks in the ocean to a point at which its hull displaces a weight of water equal to the weight of the ship. As the weight of its cargo is added, the deeper the ship sinks into the water and the greater grows the upward or buoyant force to equalize and balance this additional weight.

One property of liquids which has become of greatly increased importance in physical science is that called surface tension, This is the property which makes raindrops round, instead of square or some other shape. It

ILLUSTRATING THE LAW OF MACHINES



The wire attached to the scale pulls the big wheel around, and this winds up on the little wheel the wire attached to the 20-pound weight. The leverage ratio between these two wheels enables a one-pound pull to lift 20 pounds, yet the work accomplished is no greater than the work applied, for the one-pound pull has to move 20 inches to raise the 20-pound weight one inch.

ity. Surface tension may be considered as a force tending always to make the liquid surface shrink as though it were a stretched sheet of rubber. (See Water.)

Science of **Pneumatics**

Mechanical principles as they apply to gases comprise

the science of pneumatics, including air pressure, the barometer (see Barometer), the applications of compressed air and other gases, and the like. The chief principles of pneumatics are expressed in the Gas Laws, known as Charles' law, Avogadro's law, and Boyle's law (see Gas). These laws are not quite exact, except for the hypothetical "perfect gas," which does not exist. For actual gases the laws must be slightly modified. One practical conclusion that can be deduced from Boyle's law is that when a gas at a constant pressure is heated it will expand. This is why heated air next to the hot radiator in a room expands and rises. Another conclusion is that if a gas at constant

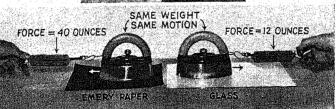
volume is heated its pressure will increase, which is why superheaters are employed in boilers, and superheated steam is used to increase efficiency of steam engines. Most of the important facts about the practical behavior of gases can be deduced from Boyle's simple law. (See also Pneumatic Appliances.)

Sound, a Mechanical Product

The study of sound is an important branch of physics. Though usually treated separately because of the special part it plays in our lives, its laws are simple outgrowths of the mechanics of matter. Sound is due to the elasticity of substances, whether

solids, liquids, or gases, which causes them to vibrate rapidly as they recover from the impact of some force which has deformed them. just as a weight fastened to the end of a spring and dropped will move up and down

FRICTION-FRIEND AND FOE



The Indians used friction to start their fires. They whirled a pointed stick in a notch cut in a piece of wood until the flames burst out. Above we see an electric drill giving a modern labor-saving demonstration of this feat. Below is a simple graphic story of how friction consumes power. Yet when properly applied, the frictional property of emery paper is, of course, extremely valuable.

for a time before it comes to rest. The vibrations can be transmitted by the substance that suffered the initial impact to other substances with which it comes into contact, but cannot cross a vacuum. (See Sound.)

Effects of Heat

All heat is the result of molecular motion (see Heat). things move in justiness that sets molecules into more vigorous vibrapiston, for examption. Among other effects, this HOW HEAT MOVES AIR AROUND

tion. Among other effects, this makes a solid expand; so that railway rails, pavement sections, and the like are longer in summer than in winter, and this is why small gaps must be left between them to allow for this expansion. Heat in liquids produces similar expansion. a fact of which use is made in the ordinary mercury thermometer (see Thermometer). Too much heat agitation of the atoms or molecules in a solid causes melting: too much in a liquid transforms it into a gas. Cooling, on the other hand, reduces the internal agitation and causes condensation or freezing (see Evaporation: Freezing).

Steam engines are really heat engines. Heat applied to the

water in the boiler greatly increases the activity of the water molecules until these are driven off as gaseous steam. This expands in the cylinder of the engine and does work by driving back the piston. Thus a part of the original heat is converted into motion and develops useful power (see Power). The science which treats of such transfers, conversions, and uses of heat is called thermodynamics.

There are two principal Laws of Thermodynamics, the first of which states: that all forms of energy are expressible in terms of heat and work. The second law of thermodynamics states in substance that it is impossible to devise a mechanical system in which, without external assistance, energy once dissipated will reconcentrate itself. In other words, heat that has spread throughout a body will not collect itself again in a smaller area of that body; heat will not of itself pass from a colder body to a warm one.

Motion can be converted into heat, as well as heat into motion. Virtually all the power absorbed in friction, for example, appears as heat. That is why rough or poorly oiled bearings become hot and melt. A definite amount of mechanical work always produces the same quantity of heat, this being called the mechanical equivalent of heat.

In no machine which changes heat energy into mechanical work is all of the heat applied changed completely into its theoretical equivalent in mechanical energy. In a steam engine, for example, the heat set free from the coal used as fuel is not entirely transformed into power, for actually many losses

occur, like the energy lost in friction. Even though the engine were mechanically perfect, the heat energy would not be completely transformed, because such heat energy is due to the random, undirected action of molecules, and it is impossible to make these tiny things move in just one direction, as against the piston, for example. The efficiency of a machine

The efficiency of a machine is the ratio of the work (or heat) obtained, to the work (or heat) applied.

Chemical and Electric Energy

The relation of heat to other forms of energy is closer than might at first thought be apparent. Chemical reactions, for example, may all be divided into two classes—those that release heat and those that absorb heat (see Chemistry).

Electric energy, with its inseparable companion magnetism, is due to the tiny particles of matter called electrons, set in motion by heat or by other forms of energy derived from heat (see Electricity). The laws that govern the motions of those particles are in all fundamental respects the laws that

COLD AIR MOVING DOWNWARD UPWARD

This glass-fronted box with two chimneys rising from it provides a graphic demonstration of the influence of heat on air currents. A candle is set burning under the chimney at the right. The rise of hot air through this chimney draws cold air down through the other chimney, as the smoke from a smoldering bit of cloth clearly shows.

govern larger masses of matter. The most familiar application of their motion is when it is transformed back to heat again in our electric lights.

The Energy of Radiation

The forms of energy that we have so far considered are inseparable from matter in the ordinary sense of that term. Mechanical energy, sound, heat, and electric energy are transmitted from one substance to another, but never gain independent existence. There are, however, forms of energy which are not bound down in this fashion. Though they originate in the motions of material particles, they are able to go out and travel across space which so far as we know, is "empty." These forms of energy are called radiation.

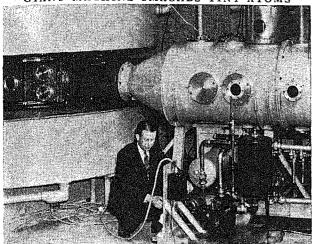
Light is the best-known example of radiation. Heat waves (not to be confused with heat itself), radio waves (not to be confused with electricity), ultraviolet rays, X-rays, the gamma rays of radium, and cosmic rays are the other groups. These are all related to one another, forming the great family of electromagnetic energy. They vary in wave-length, but they all arise from violent disturbances in the structure of matter and they all travel through space at the same rate, 186,270 miles per second. (See Light; Radiation; Radio; Spectrum and Spectroscope.)

The New Physics

Studies of these energy forms and their relations to matter have played an important part in the development of the "new physics," mentioned earlier.

The new physics began with the discovery in the closing years of the last century that the atoms or

GIANT MACHINE SMASHES TINY ATOMS



Dr. Ernest O. Lawrence is shown here with one of his cyclotrons. In the chamber at the left, magnets whirl protons up to a speed equivalent to 50 million volts of energy. Then the protons pass into the cylinder at the right, where they strike and smash their atom targets.

"indivisible particles" which were believed to be the ultimate foundation of matter were not so indivisible as they seemed, but were composed of still tinier particles called electrons and protons (see Atoms and Electrons). Starting in 1900, science also began finding evidence that energy, instead of coming in smooth "flows" from which any part could be taken, comes in definite "spurts" or "particles"; and it called the amount of energy in one "particle" a quantum (see Energy). In 1923 A. H. Compton broadened the quantum idea, which had arisen from studying heat, by discovering the "Compton effect" in working with X-rays. He bombarded a target with X-rays, and found that "recoil" electrons were driven off, while the energy in the rays themselves seemed to bounce too, as though the energy and the electrons were billiard balls in a collision. Furthermore, the X-ray seemed to lose energy, because its vibration rate became slower. Such results could not be understood if X-rays were waves, but were just what might be expected if the X-ray energy traveled in particles.

"Smashing" Atoms

During the next few years, experimenters developed high-power X-ray tubes and other devices to hurl protons at targets with such terrific power as literally

to smash the "target atoms" apart into their individual protons and electrons, so that these could be studied. Discoveries tending to confirm the quantum idea followed rapidly. In addition to the protons and electrons of the older theory, physics now recognized positrons, or particles of positive electricity as small as electrons, and neutrons, a "combination" unit in which a proton and an electron neutralize each other's charges. These were discovered respectively by Carl D. Anderson and James Chadwick, in 1932.

The discovery of "heavy water" (see Hydrogen; Water) in 1931 added to the list a two-proton nucleus, called a deuton or diplon; and in 1934 Rutherford discovered "triple" hydrogen. Constant discoveries of new isotopes, or different varieties of the same element, forced revision of many theories in chemistry (see Chemistry).

But at the same time that the "particle" idea for matter and energy was being developed, other discoveries were tending to break it down. One of Einstein's theories (see Einstein) held that under appropriate conditions, "matter" would change into "energy" and "energy" into "matter." The "wave mechanics" and "matrix" theories went further, claiming that the protons, electrons, and other "particles" of matter may be just "splashes" in a universal sea of energy, such as we can see when water waves cross.

New Rules versus Old Rules

If all this seems puzzling to us, we must remember that it puzzles the scientists too. They find that the rules which worked well for

earlier problems are not precise enough to explain the new discoveries. So they must try to set up new rules to deal with these discoveries; and if some of the rules seem to contradict each other, this simply means that some of the underlying processes are not yet thoroughly understood.

We must not think, though, that the old rules are not good any longer. They are just as valuable as ever, for the processes they cover; we have simply found that they will not do when it comes to atoms. The old laws still can be used for all ordinary problems. Only



As the liquid air in the bottle pours out into a pan on the table, it cools the surrounding atmosphere so much that the moisture in this atmosphere condenses into tiny droplets that form a spreading cloud of heavy fog.

KLQFABAFQLX[

to follow the pioneering efforts of the human mind on the frontiers of knowledge. but are not essential to the education of the layman. (See Einstein, Albert.)

History of Physics

To write the history of physics would be to write the history of all the sciences. Few men can be set apart whose work is not more accurately and graphically described in connection with some specific field, such as mathematics, mechanics, astronomy, chemistry, light, electricity, and so on.

Aristotle wrote his 'Physics' about 330 s.c., and this text remained for centuries the dominant authority (see Aristotle). The Roman poet-scientist, Lucretius (98-55 s.c.), embodied the general science of his day, enlivened by his own keen observations, into his famous work, 'De Rerum Naturae'.

The Arabic scholars followed Aristotle's doctrines as did those of medieval Europe until the time of Roger Bacon who introduced experimental methods (see Bacon, Roger). Copernicus and Galileo emphasized the importance of mathematics in physical explanations and the latter developed the science of dynamics (see Copernicus, Nicolaus; Galileo). Francis Bacon fostered the doctrine that universal laws could be based on simple facts gleaned by observation (see Bacon,

Lord Francis). Blaise Pascal, French philosopher and mathematician, made important contributions to physical theory.

But it was the work of Newton that built the framework of modern physics (see Newton, Sir Isaac). From his day forward, science had sound methods for testing new theories and for planning experiments.

Among later men whose contributions may be said to have affected the whole of physical science may be mentioned Faraday, James Clerk-Maxwell, Max Planck, and Einstein,

Some Fundamental Physical Units The basic unit of force in physics is the dyne defined on page 192. Work, the product of force times distance moved has as its unit the erg, the force of one dyne acting through a distance of one centimeter. This is so small a unit that in practical work engineers usually use as a unit the joule, equal to 10 million ergs. Energy, being the capacity for doing work, is expressed in terms of the quantity of work performed or able to be performed, hence its units are the same as the units of work. Power is the rate of doing work, and its unit is the watt, equal to one joule of work per second (see Power). When the power is known, it is often more convenient to measure work done in terms of the length of time the power is acting, so we multiply the power unit by the time and again have a unit of work or energy, such as the kilowatthour (1000 watts acting for one hour). In English units, one foot-pound equals 1.35 joules, one horse-power equals 746 watts.

-REFERENCE-OUTLINE for Organized Study of PHYSICS-

THE reader will find in the following outline a survey of the principles of physics in all its branches. He will also find guides to such practical applications of those principles in daily life as serve best to make each section clear and to illustrate its important points. No effort has been made to gather together all the references to the thousands of machines, industrial processes, or natural processes governed by physical laws, as that would only make the outline excessively long and confusing. The outlines for Astronomy, Chemistry, Geography, and Industries and Industrial Arts will supplement this one in many particulars.

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Bibliography for Physics

-Books for Younger Readers:

Freeman, M. B. and I. M. Fun with Science (Random, 1943). Gail, O. W. Romping through Physics (Knopf, 1934). Huey, E. G. What Makes the Wheels Go Round (Reynal, 1940). Morgan, A. P. First Electrical Book for Boys (Scribner, 1985). Peet, Creighton. How Things Work (Holt, 1941).

-Books for Advanced Students and Teachers:

Bragg, W. H. Universe of Light (Macmillan, 1933). Dull, C. E. and Idelson, M. N. Fundamentals of Electricity (Holt,

Dull, C. E. and Newlin, I. G. Fundamentals of Machines (Holt, 1943).

Harrison, G. R. Atoms in Action (Morrow, 1941). Karlson, Paul. World Around Us (Simon & Schuster, 1936). Lemon, H.B. From Galileo to Cosmic Rays (Univ. of Chicago Press,

Small, S. A. and Collins, V. D. Simplified Physics (Dutton, 1943).

READING EARTH'S Fortunes in Its FACE

PHYSIOG'RAPHY. Between physiography, geography, and geology there is no sharp line of division. Physiography deals with the ever-changing surface of the earth and with the relation of air and water to it. It is therefore virtually identical with the study of physical geography, with special emphasis on how the physical features of the earth originated. In this aspect it is related to geology.

The atmosphere is as much a part of the earth as are the rocks. The study of the atmosphere is called "meteorology," but physiography, even in its narrowest meaning, includes the consideration of the atmospheric forces and processes which have shaped the present surface of the land. This includes the

movements of the air (winds), the moisture of the air, especially precipitation, the changes of temperature, and the chemical changes effected, directly or indirectly, through the influence of the atmosphere (see Air: Climate). The ocean, likewise, is a part of the earth. The science which deals with the ocean as such is "oceanography," but the consideration of the ocean as a part of the earth falls within the province of geology. Oceanic activities that modify the surface of the solid part of the earth fall within the scope of physiography.

All processes that work on the earth's surface have been grouped into three classes: "diastrophism," "vulcanism," and "gradation." Diastrophism in-

cludes the up-and-down movements of the earth's crust, movements which, however gentle and slow, are continually in progress. Vulcanism includes all processes connected with volcanoes (see Volcanoes). Gradation includes all processes by which material is shifted from one point on the earth's surface to an-The centers of diastrophic and volcanic activity are beneath the surface. The processes of gradation are in operation on the surface, chiefly at the plane of contact between atmosphere and land and between water and the solid part of the earth beneath it. The transfer of material in gradation is usually from higher to lower levels. Thus rivers carry débris from land to sea. They degrade the land, and the material, deposited in the sea, aggrades its bottom. Glaciers likewise carry material from higher to lower levels. They degrade the places where they gather débris, and aggrade the places where they leave it. The degradation of one place generally involves the aggradation of another. The sand and dust blown by the wind constitute a partial exception to the rule that the materials shifted about on the earth's surface are transferred from higher to lower levels, for they often pile up to form hills.

Continents, Islands, and Oceans

The greatest features of the earth's crust are the elevations known as continents, in contrast with the depressions known as ocean basins. The sharp, topographic division-line between continents and ocean basins does not correspond with the borders of the continental land areas. For a distance about the continental lands the water is very shallow. There is then a sudden descent of the bottom to much greater depths. The area beneath the shallow water is the continental shelf. Its outer border usually is about 100 fathoms below the level of the sea. From the physiographic point of view the outer edge of the continental shelf is the border of the continent.

While the explanation of the existence of continents and ocean basins is a problem of physiography, it is an unsolved problem. The continents have sometimes been looked on as uplifted portions of the earth's crust; but it would perhaps be quite as near the truth to consider the ocean basins as depressed portions. It, however, is far from certain that the surface of the solid part of the earth was ever regular. If the continents were lifted or if they were left up as the result of the sinking of the ocean basins, they are the result of diastrophism. If this was not their origin, they probably came into existence when the earth was in process of formation, whatever that process was. Smaller land masses, that is, islands, have originated in various ways. Some are diastrophic, some are gradational, and many are volcanic.

Peninsulas and Capes, Gulfs and Bays

It is the province of physiography to define, classify, and explain the origin of all sorts of horizontal irregularities of land areas. Among the horizontal irregularities of the land are peninsulas, capes, etc.—land masses projecting into the sea. Among the horizontal

irregularities of the ocean are gulfs, bays, etc.-or bodies of water projecting into the land. The sizes. positions, and shapes of these irregularities are readily expressed on maps. Not so their origin. They have, indeed, originated in many different ways. For example, the uplift of an area of sea-bottom along a line at right angles to the coast of a continent would give rise to a peninsula, like Florida. The uplift of two such peninsulas near each other might leave a gulf or bay between them. Again, the sinking of a coast allows the sea to invade the lower ends of the river valleys, forming bays, as Delaware and Chesapeake bays. When the sea converts the lower ends of adjacent valleys into bays, it leaves a peninsula between. Peninsulas and bays formed in this way are the results of diastrophism. Small peninsulas or capes, like Cape May, may be built by deposits of sand and gravel made by waves and shore currents. They are the result of gradation-in this case, of aggradation. Glaciers moving down valleys to the sea, as in high latitudes, may gouge out the lower ends of the valleys through which they pass, cutting them down far below sea level. When the ice melts, deep, narrow bays or fiords, like those of Greenland. Norway, or Alaska, are the result. Such bays are a result of gradation; in this case, of degradation, Volcanic activity on a coast line may result in extending the land, making a cape.

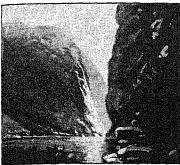
Relief Features of the First Order

Physiography has also to do with the vertical configuration of the land. The great relief types are three: plains, plateaus, and mountains.

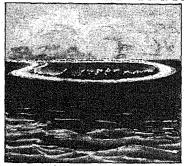
Plains are relatively low areas of considerable extent, with surfaces which are not notably rough. Plateaus are similar tracts of greater altitude, which stand up more or less prominently above their surroundings on one or more sides. Mountains usually have less areal extent, and stand up more conspicuously above their surroundings. They generally have somewhat narrow summits and steep slopes.

As topographic features, plateaus and plains may be said to differ from each other chiefly in elevation: yet there is no specific elevation above which land may not rise and yet remain a plain. Formerly, plains were often defined as lands below 1,000 feet in elevation; but this arbitrary definition has no warrant in nature or in usage. The fact is that some plains grade into plateaus and that there is no sharp line of demarkation or basis of separation which is uniformly applicable. An extensive tract of land 500 feet above the sea would probably be called a plain if it were surrounded or nearly surrounded by higher land, or if it were bordered by notably high land on one side and descended gradually to much lower levels on others. On the other hand, a tract of land 500 feet above the sea would probably be called a plateau if it were bordered on one or more sides by a tract of considerable extent which had an elevation of but 100 or 200 feet, particularly if the descent to the lower level were abrupt. Extensive areas 1,000 feet or

LAND FORMATIONS AND THEIR CAUSES



FIORDS
When the coast sinks, former mountain canyons become flords.

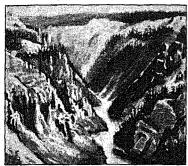


"ATOLL" ISLANDS

They are built up by coral polyps in cupshaped form on rocky foundations.



"BAD LANDS"
Strange forms cut out by violent rain storms in semi-arid regions.



V-SHAPED VALLEYS
Such valleys are "young" with their sides still unworn by the weather.



BROAD FLAT VALLEYS Such valleys are "old," filled with debris washed down from their sides.



RAPIDS AND WATERFALLS
Usually caused by the wearing away
of softer parts of the river bed.



RUGGED MOUNTAINS
These are still "young" and comparatively
unworn by wind, rain, and frost.



ROLLING MOUNTAINS
Their rounded angles have been smoothed by ages of wear.



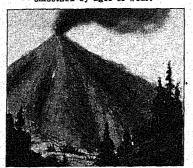
GLACIERS

They occur where moisture is constantly supplied to a frigid slope.



GEYSERS

They arise when water is turned to steam by underground fires.



VOLCANOES
Outpourings of lava and ashes gradually
build up cone-shaped peaks.



SEA CLIFFS
The pounding surf erodes the weaker rock, leaving the coast irregular.

even considerably more above the sea would probably be called plains rather than plateaus if they were surrounded or largely surrounded by higher lands, while they would be called plateaus if they stood up distinctly above their surroundings. Thus parts of the plains of the Mississippi basin are higher than parts of the Piedmont plateau lying east of the Appalachian Mountains.

Some plains originated by the elevation of shallow sea-bottom enough to convert it into land; others are the result of the building up of sea-bottom slightly above the level of the sea; others are the result of the wearing down of mountains and plateaus; and still others owe their origin to the combined action of the processes just mentioned. Subsequent to the origin of plains, their surfaces have been modified by rain, rivers, winds, glaciers, etc.

The Story of the Plains Coastal plains, some wide, some narrow, occur in many places along the borders of continents and islands. Many interior plains, like the Great Plains of North America, are often much higher than coastal plains. Most of the people of the earth live on plains, because they are more extensive than plateaus or mountains, their climate is more favorable, they have more land fit for cultivation, their rivers are more commonly navigable, and the building of roads, railways, and canals is easier. Coastal plains are likely to have flat straight coasts with few harbors. A notable exception is the Atlantic Coastal Plain, many parts of which have been lowered so that the ocean has advanced into the mouths of the rivers, thus making many good harbors. Such a coast is called a "drowned coast."

Some interior plains are the beds of lakes which have dried up; these are called lacustrine plains. The rich wheat lands in the valley of the Red River of the North, in North Dakota, Minnesota, and Manitoba, are the bed of an immense lake, called Lake Agassiz by geologists, which vanished ages ago.

Various kinds of plains are distinguished by special names in various parts of the world. The plains surrounding the Arctic Ocean, where scanty and dwarf vegetation grows on land which is perennially frozen, except for a few inches at the surface in summer, are called tundras. Inland in all the continents are vast treeless or almost treeless areas, where the prevailing vegetation is grass, which grows with incredible rapidity during the short summer months. Such plains are called steppes in Europe and Asia, prairies in North America, llanos in Venezuela, pampas in the Argentine Republic, downs in Australia, and savannas in various tropical regions. Many of these treeless plains are without forests because of too scanty rainfall; but trees flourish on many of them if they are cared for while very young.

Plateaus originated in various ways. Some have probably been elevated above their surroundings; in other cases the surrounding land may have sunk away from them; others have been built up by lava flows.

Many of them have a scanty rainfall because the high bordering mountains cut off the rain-bearing winds. Most high plateaus are too cold to be favorable to agriculture, and so have a scanty population.

Mountains are the most striking and awe-inspiring features of the earth. Where they rise abruptly to great heights every variety of climate may be found within the range of a day's travel, as in the Andes of South America. No natural feature more profoundly influences human life. They present formidable barriers to travel, and so isolate one community from another. While they have sheltered their inhabitants from invasion and have often become refuges for persecuted peoples, they have also hindered the spread of commerce, of thought, and of civilization. Often they are the backwaters of the stream of life, where the stragglers of humanity live on in ignorance and poverty. Except in fertile valleys, they are not favorable to human life, and few important cities are found in them other than along tourist routes or in mining areas. Mountains also deeply influence the life of neighboring regions, deflecting winds or robbing them of their rain so that the lands under their lee are often desert or semi-arid.

Mountains are not more sharply defined than plains and plateaus. The term mountain implies notable elevation, but a mountain is not necessarily higher than a plateau. Thus the plateau of Tibet is much higher than any part of the Appalachian mountain system. The term mountain implies: (1) a considerable elevation above surroundings, and (2) crests of limited area. An isolated elevation 1,000 feet above its surroundings, rising abruptly above a low flat plain, would doubtless be called a mountain, though an elevation of the same height with gentler

slopes on a rolling plateau might not be.

Mountains have originated in various ways: by diastrophism, as in the case of mountains formed by the upfolding of the superficial strata of the earth's crust, or by the up-thrust of blocks of the earth's crust; by volcanoes, as in the case of volcanic peaks; and by gradation. Like plains and plateaus. mountains are modified by wind and water and air after they are formed.

Minor Relief Features

The great relief forms-plains, plateaus, and mountains—are affected by numerous smaller relief features: Thus, a plain or a plateau may be affected by depressions (valleys) cut out by streams. Between the valleys remain elevations. If the elevations are long and narrow, they are ridges: if short, hills. The valleys are made: the ridges and hills are left. As a result of the excavation of valleys, plains may be far from flat. Generally speaking, the valleys are deep in proportion as the land is high. The valleys of plateaus, on the whole, are deeper than those of plains, and the ridges and hills between them are therefore higher. If the ridges or hills be very high, they may be called mountains. For example, the Catskills are simply the big hills left in the erosion or wearing away of the plateau which once existed where the mountains now are. The depressions between the mountainous hills have been worn out by running water. It is thus that mountains originate as the result of gradational processes operating on plateaus. Special names are given to special forms of hills or mountains, developed by erosion. Here belong buttes, large, flat-topped high hills developed

by erosion in arid regions; mesas, which are more extensive remnants of worn

down plateaus, etc.

Valleys are constantly being widened. Young valleys are narrow, with steep V-shaped slopes. Old valleys are wide, with gentle slopes. This widening is the result of many causes. Sometimes a stream flows against one side of its channel with such force as to undercut the slope above. The rainwater flowing down the sides carries soil with it, and thus wears down the slope. The soil also tends to slip down of its own weight, especially when it is wet. In some river valleys, however, which are called gorges if they are small and canyons if they are larger, the process of deepening has outstripped the process of widening. This happens at considerable heights where streams have great velocity, cutting their way through rock which wears away slowly, and where there is little rainfall to help wear down the slopes, as in the Grand Canyon of the Colorado (see Canyon).

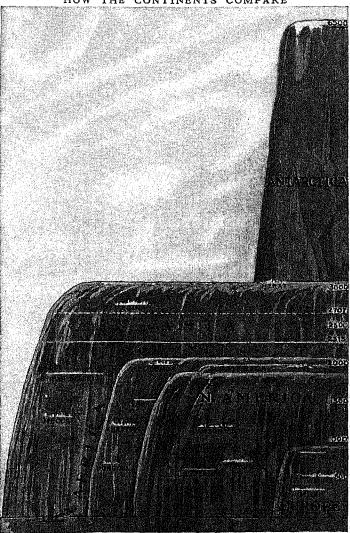
In addition to its work of eroding or wearing away the land, running water also makes changes in the earth's surface by depositing part of the load of sediment it carries. This usually occurs when its current is checked, as at the base of a steep slope. Such deposits are called alluvial deposits. Along valley bottoms, narrow alluvial plains are often developed, many of them of great fertility. In such plains, natural levees often are developed. In time of flood the current in the main channel is swift, but as the water spreads beyond its channel over the neighboring parts of the plain, its velocity is suddenly checked, with the result that it deposits part of its load in the form of low ridges on either side of the channel. In this way the Mississippi, the Indus, and

other great rivers have in places raised their level many feet above that of the plain through which they flow. Where a swift stream flows into the sea, its current is checked promptly, and its sediment is deposited, making deltas, if it is not washed away by the waves and currents. The growth of deltas

has made a great amount of valuable and fertile land, such as is found at the mouths of the Mississippi, Colorado, Amazon, Nile, Ganges, and other rivers. The growth of deltas works great changes in coast lines, the Rhone, for example, having advanced its delta about 15 miles into the sea in as many centuries.

Another topographic form is the basin. Basins, like most topographic types, are of various sorts.

HOW THE CONTINENTS COMPARE



This drawing shows how the continents would compare in bulk and average height, if they were all grouped together in solid masses of similar shape. Asia prevails in bulk, but the estimates of the Antarctic continent give it by far the greatest average altitude. The dotted line shows the average height of all the Earth's land masses including the Antarctic Continent, and the white line the average height without the Antarctic. The altitude of some important regions and cities is indicated by the names in small type.

Some are large, some small. They may affect the surfaces of plains or of plateaus, or they may occur among mountains. Some have outlets, and some have not. Those which have not may give rise to lakes, ponds, etc. Ponds and lakes may have outlets, but below the level of the outlet is a basin which



has no outlet, else there would be no lake or pond. Other so-called basins are inclosed on three sides and open on the fourth, or at least at some one point. It is customary to speak of the great depression between the Appalachian Mountains on the east, the Rockies on the west, and the height of land on the north as the Mississippi basin, although it is by no means completely inclosed by high land; but it is only a "drainage basin," and not a basin in the proper sense of the term.

Configuration of the Sea-Bottom

The configuration of the sea-bottom also falls within the province of physiography. While the seabottom is less familiar than the land, its general features are known. It is known, for example, that there are great areas of the sea-bottom elevated above their surroundings. Such areas are comparable, in some sense, to the plateaus on land. There are great areas where the ocean-bed is depressed, relatively to the areas just referred to. Such areas are comparable to the plains of the land. There are other depressions in the ocean-bed, more limited in area, which are comparable to basins on the land, though some of them are much larger, both in area and depth,

than the inclosed basins on the land. Many parts of the ocean-basin have been affected by vulcanism. Volcanic peaks are, on the whole, more notable features of the ocean-bottom than of the land. In its fundamental features or features of the first order. therefore, the ocean-bed has a certain amount of likeness to the surface of the land. But the degradational agencies are not operative on the oceanbottom, except in very shallow water. Since it is degradational agencies which produce the most notable secondary features of land surfaces, and since these agencies are little operative in the sea, the sea-bottom, in general, is without the hills, the ridges. the mountain peaks due to erosion, the valleys, valley plains, and terraces which abound on the land. These physiographic forms sometimes are found on the sea-bottom, and the areas where they occur are thought to have been land at one time, though now submerged. On the other hand, the shallow seabottom is affected by bars, reefs, etc., built by waves and shore-currents, by soil carried down to sea by rivers, and by coral polyps. Reefs are not formed on land, and are found there only when an area of sea-bottom is elevated to the estate of land.

The COMPLEX MECHANISM of the HUMAN BODY

A Glance at the Science that Tells of the Parts of the Engine of Life and Their Functions—The Many Mysteries Still to be Explained

PHYSIOLOGY. The body of the average man weighing 150 pounds contains the equivalent of 100 dozen eggs, enough iron to make 4 tenpenny nails, fat contents sufficient for 75 candles and a good-sized piece of soap, phosphate for 8,064 boxes of matches, enough hydrogen (in combination) to fill a balloon and carry him above the clouds, and besides all this, 10 gallons of water, 6 teaspoonfuls of salt, and a bowl of sugar. This gives us some idea of what we may call the chemistry of the human body. Its structure and its way of working are equally wonderful.

Now if you are going to run an automobile or a motorcycle you want to know not only what the different parts are, and of what they are made, but you must also learn how each part works or "functions," and what its purpose or use is in operating the machine. It is the same when we study an animal or a plant. The study of its anatomy (see Anatomy) will tell us the way it is built and even its minute structure, but it is the study of its physiology that tells us how each part functions when the animal is alive. And this is not quite so easily learned as the former. For when we attempt to separate the parts that we may examine and study them, we are likely to kill the animal or plant, and the very part which we wanted to examine quits work, so that we have defeated the end for which we strove.

For many centuries this was the great stumblingblock to scientists and physicians. There is still much that is mysterious in human physiology, for even today there are many activities of our bodies of which we know very little. But we are learning!

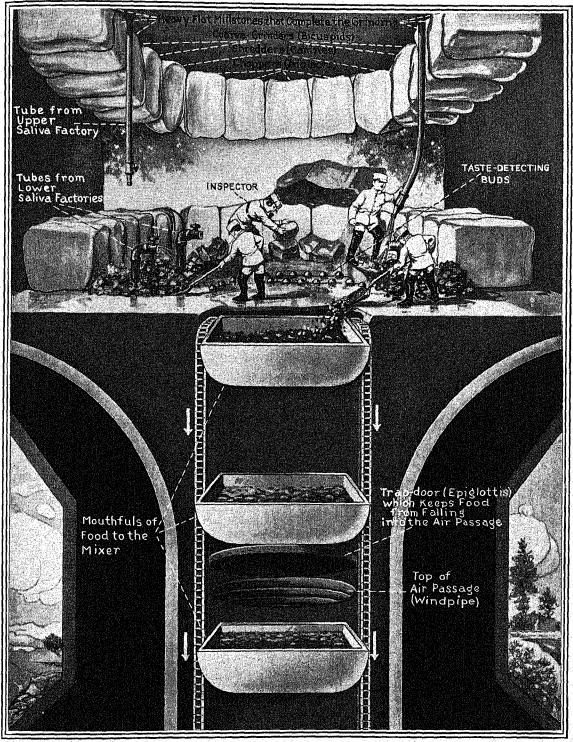
In the early days, "humors" and "spirits" were supposed to control certain functions, and anatomy, physiology, and medicine were a jumbled mass of facts and fancies. Then men of deep thought and earnest work began to make independent investigations. The microscope was invented, and they could actually see the blood flowing through the capillaries from the arteries to the veins, when the animal was alive, and other activities as well. Since then our knowledge has constantly deepened and broadened.

The Four Groups of Organs

As a result of experiment and study we have learned that, as regards its functions, every human or animal organ falls naturally into one of four great groups.

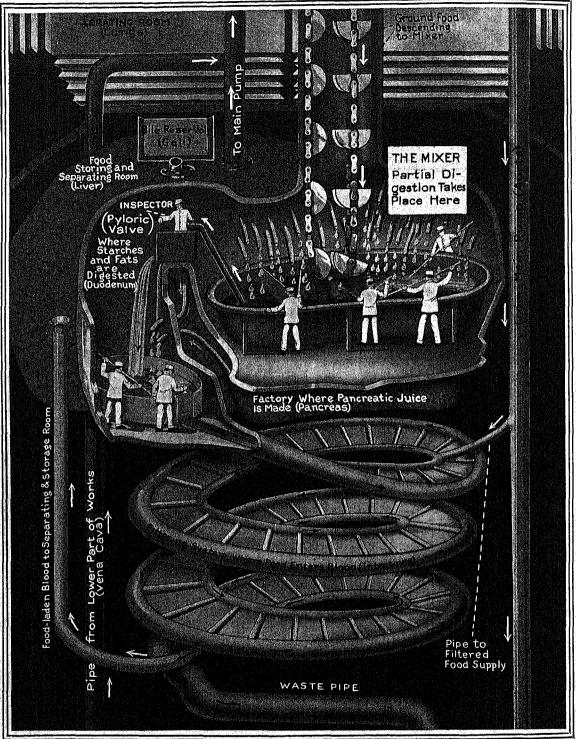
First, there are those organs whose function deals with nutrition—that is, with feeding the different organs of the body and disposing of its waste products. The blood in the animal supplies food to the different parts of the body; the heart pumps the blood; the stomach and digestive system prepare the food so that it may be taken up by the blood; the liver, pancreas, etc., help in the work of digestion; the kidneys aid in throwing off waste products; the lungs take from the air the oxygen which is needed by every living cell of the body, and throw off the poisonous carbon dioxide which is made in the various chemical changes that

OUR BODY MACHINERY-IN THE GRINDING MILL



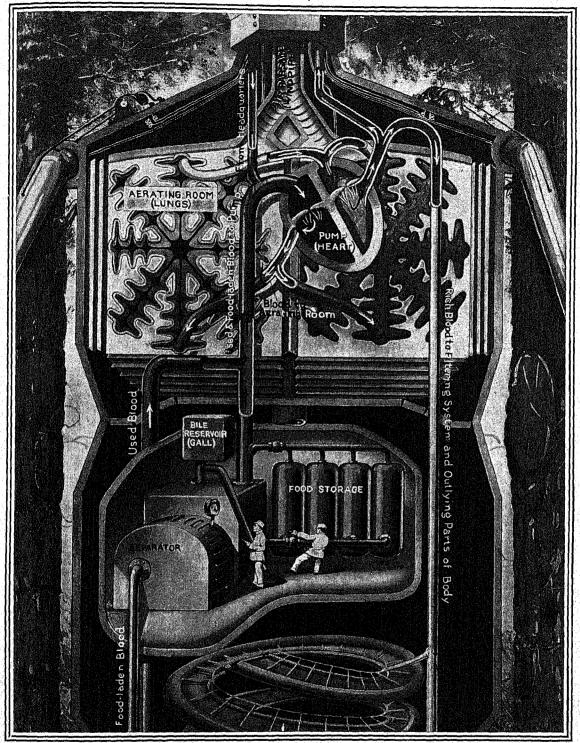
Just as locomotives turn their fuel (coal and water) into a means (steam) for applying energy to their working parts, so does our body machine have a means for turning its fuel (food) into blood for its working parts. This picture shows the grinding mill, where fuel is received and worked into shape for the succeeding processes. The first thing is inspection, just as a grain inspector examines grain at a flour mill, to see if it comes up to grade. This the mouth inspectors do by tasting it. That's what the taste buds are for. Having passed the inspectors, the food is ready to be ground up. All the food is first ground coarsely, and then finer and finer, just as in the case of wheat in a flour mill. And all this time those tubes are pouring in saliva, which softens the food and partially digests the starches. When the grinding and mixing are finished, mouthfuls of food are started on their way to the mixing room. A special trap door (epiglottis) is provided, which shuts when food comes down, and keeps it from entering the air passage.

OUR BODY MACHINERY-THE MIXING ROOM



Here we are in the mixing room itself, the stomach. The liquid juice which you see pouring out from all sides is mixed with the food, and digests the albuminates—that is, the meat, eggs, cheese, and similar substances. See that little man standing at the passageway between the stomach and the duodenum? He's the inspector, and any food that has not been properly mixed with the gastric juice he sends back for further treatment. The starches and fats, although still unalgested, are allowed to pass by because they are to be digested in the duodenum. The digesting is done by the bile and the pancreatic juices you see dripping from those two pipes, and the intestinal juices. Out of the duodenum the food passes into the intestines, represented by that long coiled tube, and as it passes along, the useful part of it is taken out and emptied into the blood, while the waste is disposed of through the waste pipe. Back of the stomach is the food and separating room (the liver) in which wonderful things are going on, as we shall see in the next picture.

PURIFYING, SEPARATING, AND STORAGE ROOMS



We have just had a glimpse of the outside of that wonder-working department of the human system known as the liver. We saw entering into this the food-laden blood from the intestines. Here we can see plainly what happens to this blood after it enters the liver. Here the biliary secretion is separated from the blood, and made into bile. The gall bladder is a reservoir for the accumulation of bile, when its flow into the intestines is, for any reason, interrupted. The liver also makes many important chemical changes in the food substances. The pipe leading from the separating rooms empties into the one carrying the used blood from the lower parts of the body, and the two streams, thus united, flow to the heart. There the pumps force the blood to both sides of the acrating room (lungs), whose spreading branches expose it to the purifying air. The purified blood, enriched by the food supply, enters the left side of the heart, and is distributed over the body by the action of this pump.

take place throughout the system; the skin is also active in throwing off waste products. So each of these organs deals with nutrition and the nourishment of our bodies.

In the second group we place those organs whose work deals with relation—that is, whose function is to bring us information of the outside world about us (the eye, ear, nose, organs of taste and touch) and tell us our relationship to it. In this group we may place the muscles, which control our movements and hence our relation to people and things; and also the bones, which support and protect our bodies and are used as tools and levers by the muscles. The business of each of these parts of our bodies concerns our relation to the world of things about us or the interrelation of the parts of the body.

Organs of Intelligence

The third group contains the organs of intelligence, which include the brain and nerves. These receive sensations, store up impressions as memories, make decisions and plans, and transmit suggestions and orders to other parts of the body. The quickness and clearness with which this group functions is considerably affected by the general health of the first and second groups. The old Roman adage, "a sound mind in a sound body," was founded on physiological fact. The fourth and last group contains those organs whose work it is to reproduce the species. These are known as the organs of reproduction.

Nothing appears simpler than chewing and swallowing a mouthful of food; yet what a wonderful lesson in physiology is presented by this commonplace action! There is the tongue, which tastes the food, manipulates it in the mouth, and forces it back into the throat; the teeth, which crush and grind the food; the saliva, which softens it, eases its passage down the throat, and instigates the early stages of digestion (see Teeth; Tongue). The very sight or smell of tempting food stimulates the three sets of salivary glands—the parotids in the cheek, just beneath and in front of each ear (one who has had the mumps can locate them easily, for mumps is a swelling of the parotid glands); the submaxillary, under the angles of the jaw; and the sublingual, beneath the tongue.

The throat chamber, or *pharynx*, at the rear of the mouth is more than a mere vestibule into the gullet. Six passages lead out of it: two go upwards to the nose cavity; two, the tiny Eustachian tubes, lead to the ears; one, the glottis, is the slitlike opening to the windpipe; and one leads to the gullet or esophagus.

The Food Starts Its Journey

At the rear of the palate or roof of the mouth, hangs a small projection, the *uvula*, and over the glottis is a lid called the *epiglottis*. During the act of swallowing, the uvula moves backward to block the way to the nose, and the epiglottis closes the opening to the windpipe. At the same time, the muscles that surround the throat cavity quickly close in and force the food down.

The food is now in the esophagus, a straight tube which traverses the length of the chest cavity and

passes through the diaphragm as it nears the stomach. Like the mouth and all parts of the alimentary canal, the esophagus is lined with mucous membrane, a soft thin covering which secretes mucus, and so furnishes a moist surface for the passage of food. Muscular rings in the wall of the esophagus contract and force the food slowly toward the stomach.

The Chest and Abdomen

The body cavity itself, technically called the coelon. should be considered at this point. It is divided by the diaphragm into two chambers, the thoracic or chest cavity, and the abdomen (see Diaphragm). The chest is a movable rigid box supported by the ribs and inclosing the heart and lungs (see Lungs; Respiration). The abdomen contains the stomach, intestines, liver, and all other internal organs. Attached to the surface of the chest walls, and enfolding the lungs, is a serous membrane called the pleira. Similarly, the abdominal cavity is lined with another membrane, the peritoneum, which also incloses the abdominal viscera. These membranes help support the organs and secrete a liquid resembling serum which provides a slippery surface. Hence, the organs can glide against one another and against the body walls without friction. It is these serous membranes that become inflamed in cases of pleurisy and peritonitis.

The esophagus communicates with the larger end of the pear-shaped stomach, and at the stomach's narrowed end, or pylorus, the small intestine begins. What happens to the food inside the stomach is itself a long and complex story described elsewhere (see Digestion; Stomach). The pylorus, a "gatekeeper" according to its Greek meaning, opens at the proper time and allows the food in the stomach to pass on into the small intestine.

This portion of the alimentary canal is a much-coiled tube to allow great space for soaking up or absorbing digested food. Absorption is one of the principal functions of the small intestine, and its adaptations for absorption are its most wonderful features. The lining of the small intestine is elevated into crescent-shaped ridges, which, like little dams, delay the onward flow of food, and increase the absorbing surface. In addition, these ridges of mucous membrane are covered with tiny velvet-like projections, called villi, so named from the Latin word meaning "shaggy hair."

Function of the Lacteals

Through the center of each villus passes one or more fine white threads, the *lacteals*, so called because of the milklike appearance of their contents. Their principal function is the absorption of fat. The lacteals are part of the lymphatic system, a system for draining lymph back into the blood stream. *Lymph*, a clear watery liquid, is simply blood plasma which has soaked out through the capillaries to nourish the cells of the body (see Blood). When lymph is charged with fat droplets, as happens in the lacteals, it is called *chyle*.

The fat absorbed by the lacteals is conveyed by lymphatic vessels to the large thoracic duct which runs upward along the spine. This duct empties into R. D. TREFELD S

veins at the root of the neck. Here the fat meets with venous blood from the head, largely carried downward by the jugular vein, and so passes onward to the heart. Other liquefied food substances, absorbed by the numerous blood-vessels which line the villi, enter the blood stream directly, but before reaching the heart, pass through the liver, where the sugar is removed and stored in reserve form (glycogen) for the future needs of the body (see Liver).

Some of the fat is also stored away for future use as adipose tissue, but is not confined to any one region or organ. This tissue forms a layer underneath the skin to keep the body warm and give it a rounded appearance, and, when oxidized, furnishes heat and power (see Biochemistry). It also acts as a cushion for many organs, such as the heart or kidneys.

The large intestine begins as a saclike pouch called the *caecum* or "blind sac," then, as the colon, takes a somewhat rectangular course, up, across, and down the abdominal cavity, and passes to the exterior by a short straight tube, the rectum, by which undigestible and waste substances pass out from the body.

As we follow these processes, we are bound to ask what coördinates and controls them all. In addition to the central nervous system, with brain, spinal cord, and nerves going out to all parts of the body (see Brain; Nerves), we find in man and other vertebrates two knotted nerve cords strung along the outside of the spinal column, one on either side. The knots, or ganglia, are simply masses of nerve cells whose fibers form the connecting cord. This series of ganglia is the basis of the sympathetic nervous system, which presides over the processes of nutrition and growth.

One set of nerve fibers connects the sympathetic ganglia with the central nervous system, and another set goes out to the organs of digestion, respiration, circulation, and excretion. The sympathetic nerves unite with each other in fine networks or plexuses. One great network, for example, the solar plexus, situated at the pit of the stomach, sends branches to various blood-vessels and organs within the abdomen. Another, the cardiac plexus, lies near the heart. A third, the hypogastric plexus, is in the lower part of the abdominal cavity. The chain of ganglia along the spine, and the smaller ganglia in the plexuses, serve as true nerve centers to regulate the action of organs over which we have no voluntary control, such as the peristaltic movements of the intestines. Since this nervous system is largely independent, it is often spoken of as the autonomic nervous system.

There are chemical as well as nervous regulators of the body. When, for instance, the food has passed through the stomach and enters the intestine, a new set of digestive juices is required from the pancreas. Whenever the intestine is touched by an acid (food coming from the stomach is acid), its cells secrete a hormone which is passed into the blood (see Glands). This hormone, upon reaching the pancreas, rouses this tissue to active secretion. The secretion is passed down a duct into the intestine, and a new phase of digestion is begun.

The cooperation between the various organs of the body, the way in which their functions interlock, and the astounding harmony of it all—that is the great lesson of physiology.

Closely related to the study of physiology is the study of hygiene. Anatomy tells us how the organ is made; physiology tells us how the organ works or functions; and hygiene tells us how to care for it and keep it well (see Hygiene).

So closely are these subjects related, and so important is a knowledge of them to our well-being and happiness, that we have made laws compelling them to be taught to the child in the schools. Knowing how our eyes are made and how they work, we also know how to protect and care for them so that they may serve us faithfully as long as we live. Knowing how our bodies are made, and how the various organs function, we will not take into them narcotics or stimulants or any other poisons which injure and break down the parts of these wonderful machines. For we learn that when any organ is not properly working, some other organ must work harder to counteract this defect. Only when every part is doing its work well can we be happy.

The physiology of plants is in principle the same as that of animals, but is much simpler, as the activities of plants are simpler than those of animals and human beings. Nutrition and reproduction are the main branches of plant physiology. In the higher plants the root is an organ of nutrition for absorbing water, mineral salts, and organic matter which is soluble in water. The root, leaves, and stems are furnished with strands of tissues along which the water and food can travel readily. The leaves and at times the stem are organs for absorbing the carbon dioxide which the plant needs and for giving off oxygen, and they are also important in helping the plant to manufacture its food. And the flowers and seeds, which play so large a part in all the higher plants, are simply organs of reproduction to insure that the species does not die out. In addition all plants are more or less sensitive to sunlight, moisture, and other chemical influences, and even at times show movement in response to such stimuli; so we may say that there are some traces of organs of relation. (See Plant Life.)

-REFERENCE-OUTLINE for Organized Study of PHYSIOLOGY, HYGIENE, and MEDICINE-

A SOUND knowledge of the structure of the human body and the normal functions of its various parts is an essential of modern life. It encourages healthful habits, prevents groundless fears of disease, and brings an understanding of many problems that obstruct the progress of the human race. This outline presents a brief

survey of the chief parts of the body and their work, the simple laws of hygiene, and a few of the outstanding features of medical history and practise. It should be supplemented by studying the outline for Biology, which reviews the general laws of life in a more comprehensive manner; the outline for Home Economics, which RELECTION OF THE RELECTION OF THE PROPERTY OF

offers a more complete survey of foods and food values; and the outline for Education, which includes those aspects of psychology that have a bearing on the formation of healthful mental habits.

- HUMAN PHYSIOLOGY AND ANATOMY: P-202, A-191.
- The Framework of the Body:
 - a. Skeleton: S-154, V-290.
 - Composition of Bone: B-172.
 - c. Hand: H-207; Foot: F-146.
 - d. Joints and Ligaments: S-156.
- B. Muscles-How the Body Is Moved: M-304, B-110.
- Digestion—the Process by Which Food Is Changed So That It Can Be Absorbed by the Cells: D-68, B-110.
 - a. The Mouth, Throat, and Salivary Glands: P-206. b. The Teeth—Preparing Food for Digestion: T-28.

 - The Esophagus: P-206.
 - d. The Stomach and How It Works: S-292.
 - The Small and Large Intestines: P-206.
 - The Liver-Largest Gland in the Body: L-165.
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 - g. Johannes Müller and Claude Bernard, Founders of Physiology: (Fact-Index).

- h. Sir James Simpson, Crawford Long, and William Morton, Pioneers in Anesthetics: A-196.
- Rudolph Virchow, Father of Modern Pathology: (Fact-Index).
- Louis Pasteur, Father of Bacteriology: P-86, A-222.
- k. Joseph Lister, Father of Antiseptic Surgery: A-222, H-345, I-116.
- Robert Koch, Investigator in Bacteriology: G-78. m. Charles Laveran, Sir Patrick Manson, and Sir Ronald Ross, Conquerors of Malaria: M-268, P-46.

Bibliography for Physiology, Hygiene, and Medicine

-Books for Younger Readers:

Baruch, D. W. and Reiss, Oscar. My Body and How It Works (Harcourt, 1934).

Charters, W. W. and others. New Health and Growth Series, 8v. (Macmillan, 1941).

Cole, N. B. and Ernst, C. H. First Aid for Boys (Appleton-Century,

Crampton, C. W. Boy's Book of Strength (McGraw, 1936). Crisp, K. B. Be Healthy (Lippincott, 1938). Ferguson, H. W. Child's Book of the Teeth (World Bk. Co., 1932).

Keliher, A. V., ed. Doctors at Work (Harper, 1941).

Rifkin, Lillian. When I Grow Up, I'll Be a Nurse (Lothrop, 1942). Ritchie, J. W. Primer of Sanitation (World Bk. Co., 1925). Towse, A. B. and others. Health Stories, 3v. (Scott, 1934–39). Turner C. E. and others. Health, Safety, Growth, 6v. (Heath, 1941). Williams, S. J. and Charters, W. W. Safety (Macmillan, 1941).

-Books for Advanced Students and Teachers:

Anatomy and Physiology De Schweinitz, Karl. Growing Up (Macmillan, 1935). Hickman, C. P. Physiological Hygiene (Prentice-Hall, 1942). Kimber, D. C. and others. Textbook of Anatomy and Physiology (Macmillan, 1938).

Martin, H. N. Human Body (Holt, 1934). Stiles, P. G. Human Physiology (Saunders, 1936).

Personal Hygiene

Cobb, W. F. Health for Body and Mind (Appleton-Century, 1941). Fisher, Irving and Fisk, E. L. How to Live (Funk, 1938). Howard, F. E. and Patry, F. L. Mental Health (Harper, 1935). Your Carriage Madam! A Guide to Good Posture Lane, Janet. Y (Wiley, 1934).

Williams, J. F. Personal Hygiene Applied (Saunders, 1941)

Food and Health

Eddy, W. H. and Hawley, G. G. We Need Vitamins (Reinhold, 1941). Fishbein, Morris. The National Nutrition (Bobbs, 1942). McCollum, E. V. and others. Newer Knowledge of Nutrition (Macmillan, 1943

Sherman, H. C. and Lanford, C. S. Essentials of Nutrition (Macmillan, 1943

Silver, Fern. Nutrition (Appleton-Century, 1942).

Public Health and Hygiene Chenoweth, L. B. and Morrison, W. R. Community Hygiene (Crofts, 1941).

De Kruif P. H. Health Is Wealth (Harcourt, 1940).

Heiser, V. G. American Doctor's Odyssey (Norton, 1936). Meyr, Berl ben. Your Germs and Mine (Doubleday, 1934). Nyswander, D. B. Solving School Health Problems; the Astoria

Demonstration Study (Commonwealth Fund, 1942).

Soule, E. S. and MacKenzie, Christine. Community Hygiene (Macmillan, 1940).

MedicineAmerican Red Cross. First Aid Text Book (Blakiston, 1942). Darnall, J. R. and Cooper, V. I. What the Citizen Should Know about Wartime Medicine (Norton, 1942).

De Kruif, P. H. Men Against Death (Harcourt, 1932). Flikke, J. O. Nurses in Action (Lippincott, 1943). Ratcliff, J. D. Modern Miracle Men (Dodd, 1939).

Rosenau, M. J. Preventive Medicine and Hygiene (Appleton, 1935). Silverman, M. M. Magic in a Bottle (Macmillan, 1941). Wilson, C. M. Ambassadors in White (Holt, 1942).

The STORY of the PIANO and its ANCESTORS

PIANO. Near the close of the 17th century, a wealthy Italian prince of the Medici family hired Bartolommeo Cristofori to take charge of his collection of musical instruments. Cristofori was a harpsichord maker and so was especially interested in this and other instru-

ments played by a

keyboard. These forerunners of the piano were of two general kinds: (1) the harpsichord type, in which the strings were plucked by quills or pieces of leather that rose and twanged the strings when the key was struck; (2) the clavichord, in which the strings were struck by brass wedges, or Vir-"tangents." ginals, psalteries, and spinets were

small instruments of the harpsichord family. Most of them had a small range, with only one string to a note, and were placed on a table for playing, though some harpsichords were large and shaped like a modern grand piano, with two, three, or four strings sounding in unison for a single note, thus increasing the volume of tone. The most elaborate harpsichords had double keyboards—one for producing soft tones and the other for loud toneswith stops and pedals for varying the effect. Some of them were upright, like an upright piano. Usually the spinet was small and each one of its notes had a single

string plucked by a crow's quill or a piece of leather. A popular model is described as resembling a harp laid in a horizontal position, having its longest string only a foot in length, and with a compass of 31 notes.

Our knowledge and appreciation of these early instruments have recently been greatly increased by Arnold Dolmetsch, who devoted his life to col-

lecting and making them and to demonstrating their qualities in concert work.

All these instruments lacked means of sustaining tones and were not easily controlled to bring out contrasts of loud and soft. Cristofori set himself to remedying these defects, and in 1709, 1720, and 1726



This instrument, built by Cristofori in 1720, now considerably restored, may be seen at the Metropolitan Museum, New York City. It is one of the two oldest planos in existence. Its brother of 1726, also by Cristofori, is in the Kraus Museum, Florence.

built instruments which gradually developed into the modern piano. The name piano is a shortened form for "pianoforte," given to the new instrument because it could readily be played either soft (Italian piano)

to be transcribed and adapted to the larger and more melodious instrument, as for example, the worldrenowned Czerny's pianoforte editions of the 'Preludes' and 'Fugues' of Johann Sebastian Bach.

Making Pianos

The wood for a piano is chosen by a workman so expert that he can tell by its sound when it is struck whether it has the necessary qualities of resonance. Then it is weather-seasoned from three to ten years, and afterwards artificially dried for weeks.

The case consists of two sides or rims made up of many thin strips of wood bent to shape and glued together. They are supported and held in place by posts of heavy timber. These posts and the inner rim form the frame, or skeleton, of the instrument over which a thin, highly polished veneer of wood is laid. To this frame, at its front end, is attached the "wrest-plank" or pin-block, into which the tuning-pins are driven.

Over the framework as a whole is laid the convex or arched sounding-board. which is securely fastened at its edge to the inner rim. Over the sounding-board in turn is placed a metal plate to hold the strings, which are drawn across the plate from the tuning-pins at its front end to hitch-pins at its rear. The positions of these pins are carefully determined so that string tension may be nicely proportioned throughout. action is then adjusted in such a manner that a felt hammer, upon being brought into play by the depression of its key,



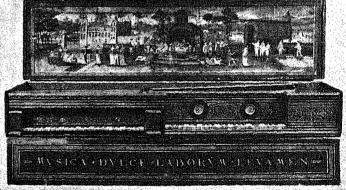


or loud (forte). The essential feature of the mechanism which accomplished this was the use of little leather hammers operated by a hinged lever—the same principle that is used in the action of the pianos of today.

There were, however, many defects in these early instruments, which kept them from becoming generally popular among musicians. Bach, Haydn, and Mozart continued to write for the harpsichord and the clavichord, though Mozart had a piano for his personal use; and it was not until many improvements had been made that the piano was fully accepted.

Beethoven was the first great composer to write for the pianoforte.

Much of the great music of earlier masters, who wrote for the harpsichord or the clavichord, has had



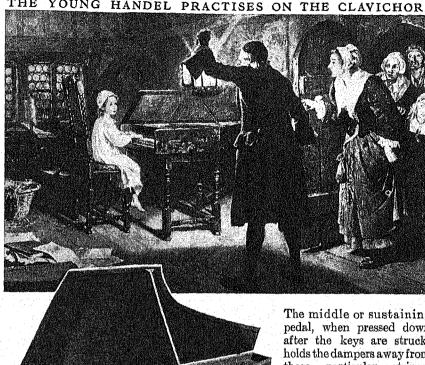
The harpsichord of the elegant Dutch lady in the painting by J. M. Molenaer, now in the Ryks Museum, would sound odd and tinkly today, compared to a modern piano. But how fine is the painted scene on the inside of the lid, and also on that of Hans Ruckers' double virginal, below, made in 1581.

strikes a string or a group of strings in unison, and thus makes it vibrate.

The strings, in being drawn from the front to the rear end of the plate, pass over a bridge, which is THE YOUNG HANDEL PRACTISES ON THE CLAVICHORD

glued to the soundingboard. Determining the proper height of the bridge is a delicate matter. If the bridge is too high, the downward pressure of the strings overbalances the upward pressure exerted by the arched board; if too low, opposite results follow. As the strings are set vibrating by the hammer blows, the vibratory motion is communicated through the bridge to the sounding-board, and thereby amplified and reinforced.

The best way to understand the action is to take out the front board of an upright piano and look inside. Press down a key and you will see how its rear end rises and lifts the "jack," which throws the hammer against the strings while raising the damper from them. You will see, too, how the dampers stop the strings from vibrating when you lift your hand from the keyboard, and how you can keep them vibrating, when you have taken your hand from the keys, by keeping down the right (damper) pedal. The left (soft) pedal in upright pianos shifts the hammers, so that their stroke is shorter and lighter; in grand pianos, it shifts the keyboard, so that only two of the three strings for each note are struck.

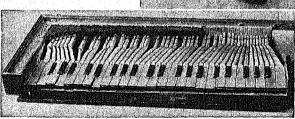


The middle or sustaining pedal, when pressed down after the keys are struck, holds the dampers away from those particular strings; whereas, the damper pedal holds the dampers away from all the strings.

The tone of a piano depends to a considerable extent on the length and size of the strings, and on the resonance space. This fact accounts for the superiority of the grand piano over smaller instruments. concert "grand" of today has three strings (tuned in unison) for most notes, but some of the bass notes have two strings, and the lowest notes have one. The frame is steel, the wires are stronger. and the heavier strings are wound with smaller wire.

The standard piano keyboard has 88 notes, giving a compass of seven octaves and a minor third. Instruments designed to take up little space may have fewer.

The United States has contributed several noteworthy improvements to piano making. The upright piano was invented about 1800 by John Isaac Hawkins, an Englishman living in Philadelphia. Alphaeus Babcock, in the early 19th century, made a single casting of iron for the plate of his square piano; and Jonas Chickering, shortly after, applied this for the grand. Since 1885, this single metal plate casting with crossover-stringing, by



When George Frederick Handel was a little boy, his barbersurgeon father objected to his interest in music. So the lad slipped
out of bed at night to practise on a clavichord, a soft-toned instrument, which a friend had put in the attic for him. The top picture, by
Margaret Isabel Dicksee, shows the boy discovered. The elaborate
harpsichord in the center was made by Jans Couchet about 1650.
Below we see a German clavichord of the 17th century.

which the lower strings cross the others diagonally, has been generally adopted. The total tension on the plate is over 30 tons! A tension regulator was intro-

duced by Mason and Hamlin, of Boston, in 1900.

To American inventive talent we also owe the player-piano, for the first mechanical piano was built in 1887 by Edward White of Meriden, Conn. In one type the operator controls levers that control the "expression": soft, loud, sustaining, and time. In the other, the rolls of music regulate all the playing. These are called "master" or "autograph" rolls, for great pianists and composers have signed their names on them to show that they have authorized the playing of the music as it is recorded.

The mechanisms of the

player-pianos differ in many details, but the basic principles are usually similar. Each note of music is represented on a roll by a small perforation. As this

passes over a tracker bar (see illustration on opposite page), air pressure is released that causes a hammer to strike a string in the piano. Thus air and perforations

in paper take the place of the pianist's fingers.

acquiring dexterity of touch and technique independent of tone.

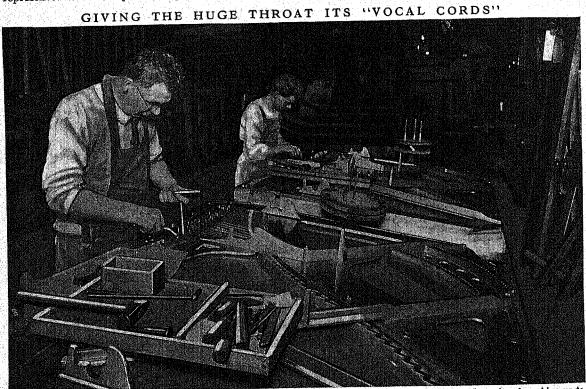
The Jankó keyboard, invented in 1882 by Paul von Jankó, a Hungarian musician, consists of six rows of keys in steplike Some of its succession. advantages are that all diatonic scales can be fingered exactly alike, and that it is possible to stretch with one hand a 13th as compared with the ordinary stretch of an

The Virgil clavier is another American invention. This is a silent keyboard mechanism with adjustable touch (light or heavy) for

octave, or eight notes. Emanuel Moor in 1921 invented a double-keyboard piano. The upper keyboard is tuned an octave higher than the lower, to which it



When the sounding-board, with the bridge fastened upon it, has been set in place, skilled workmen drill the holes for the series of plus across which the strings will pass.



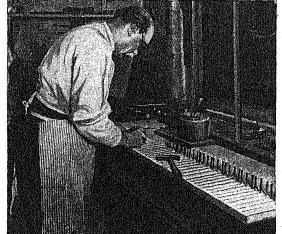
Here workmen are beginning to attach the strings, beginning with the short steel wire strings at the treble end and working up to the heavy strings of the bass overspun with brass. The metal plate and the pegs to which the 220 strings are attached must be very strong, because the united pull of the strings is about 30 tons.

may be coupled in octaves in somewhat the same way as organ manuals may be coupled together.

Why the Piano Is "Out of Tune"

Do you know that neither the piano nor the organ is ever exactly in tune? To explain why it is not, we must consider scales as altogether disconnected from keyboard instruments. The diatonic scale, which is the basis of modern music, has eight notes, which bear a definite ratio of frequency to one another. If we start with C, for example, and represent its frequency as 1, we

find that the eight notes of that scale have, in relation to C, the following frequencies of vibration:



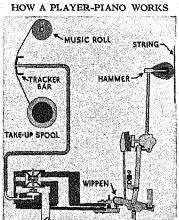
The delicate task of attaching the strips of ivory to the keys is assigned to an expert workman,

TOW A DI AMED DIAMO MODE

Interval with C Relative Note Frequency С D 9:8 second E major third 5:4 F fourth 4:3 G fifth 3:2 A B major sixth 5:3 seventh 15:8 octave

While the note A in relation to the note C, taking C as 1, has a relative frequency of 5 to 3, the same note A in the scale of G, where it is the second note, has a frequency of 27 to 16. The difference between these two A's is 81 to 80, but it is so small that in the piano and the organ one note does for both. This equalization of slight differences in pitch is called "equal temperament." If keys were provided for all the notes that differ slightly from each other, the piano

and the organ would have keyboards of unwieldy size. The real "out-of-tuneness" of the piano may best be heard by playing, for example, the lowest C



When a perforation in the music roll uncovers a hole in the tracker bar, the rush of air between the vacuum chamber and the pneumatic causes the lower leaf to operate the wippen, which in turn throws the hammer against the string.

but one and then the highest C but one; the highest is distinctly flat. It is to Johann Sebastian Bach that we owe the solution of this problem of making one keyboard do for the whole gamut.

The piano occupies an important place in the development of music. Beginning with Beethoven, a vast amount of music has been written for it alone, and for a combination of piano with stringed instruments and piano with orchestra. The sonata is the important piano solo form (see Music), although there are many shorter

forms, such as the romance, impromptu, fantasia, intermezzo, and étude. The form for piano and orchestra is called the concerto.

As the piano itself became more perfect, the music written for it expanded and became more beautiful. It reached great heights in the music of Schumann, and more particularly in that of Chopin. Among the great pianists, Liszt stands preëminent. The piano is important to most of us chiefly because, more than any other instrument, it offers an opportunity to make our own music at home. On it can be played arrangements of symphonies, operas, and other favorite forms, which would be impossible with any but a keyboard instrument. There is music for four hands on one piano, called duets, and two or more pianos, playing different parts, produce unusual musical effects. We can use it to

accompany singing, either solo or chorus, or another solo instrument like the violin, or we can improvise music to suit ourselves.

PIERCE and His Troubled ADMINISTRATION

The Story of the President Who Had Been a Brave Soldier and a Charming Gentleman, But Who Lacked the Strong Hand of Leadership—How His Change of Policy on the Slavery Question Brought Disaster

PIERCE, Franklin (1804–1869). The 14th president of the United States was far from being a great man. From the biography written by his friend and college mate, Nathaniel Hawthorne, we see that he was a gentleman of truth and honor, with a fine

physical appearance and charming manners. Most people were genuinely surprised when he was nominated as president by the Democrats in 1852. His nomination and election over Gen. Winfield Scott, the Whig candidate, can only be explained on the ground that, in a time rich in great leaders, it was felt safer to choose one who had played no conspicuous part and made no enemies.

Franklin Pierce was the son of a Revolutionary patriot of New Hampshire who had been twice governor of his state, and he had learned from his

father a strong love of country. He was graduated from Bowdoin College in 1824, and after studying law for three years was admitted to the bar.

The prominent position which his father had occupied in the Democratic party in New Hampshire was a help to the son's political advancement. In 1829 he was elected to the state legislature and became speaker of that body. Four years later he was elected as a representative in Congress, supported Jackson's policies, and in 1837 was sent to the Senate. When he entered that body he was the youngest member in it, and as such great men as Webster, Clay, and Calhoun were numbered among its members, Pierce was completely overshadowed and his voice was never heard in debate.

Before his term in the Senate had expired he resigned-with the determination, as he said, never again to appear in public

life. This resolution was faithfully adhered to for years, in spite of the fact that he was asked to become a candidate for governor of his state, and was offered the place of attorney-general of the United States in President Polk's cabinet.

When the Mexican War broke out, Pierce followed the patriotic example which his father had set and enlisted as a private. He was soon given a commission as brigadier-general, and served under General Scott with bravery and credit. On the restoration of peace he resigned his commission and returned home to the practice of law. In 1850 he was president of a convention to revise the constitution of his state. In due time his nomination as president followed, with William R. King of Alabama for vice-president; and Pierce and King were elected by 254 electoral votes against 42 cast for Scott and Graham, the Whig candidates, who carried only four states.

When Pierce was inaugurated, on March 4, 1853, he was the youngest man who up to that time had

taken the presidential oath. In his inaugural address he promised that he would uphold the Compromise of 1850, and that the repose which it had given the country should not be disturbed; but before his administration was over he had given his support to the Kansas-Nebraska Bill, which reopened the slavery

question and led directly to the Civil War (see Kansas-Nebraska Act).

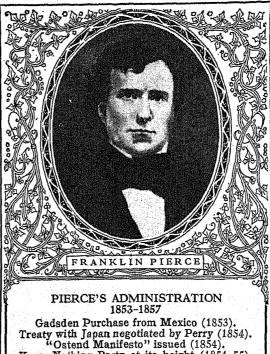
President Pierce's change of position on the slavery question was only one example of the indecision

which was evident during his whole administration. He would make up his mind on a question in the morning, and change it in the afternoon. From being the most popular man in the country at the time of his inauguration, by December 1853 he had come to be regarded by many of his countrymen as one of the most incompetent men ever in the presidency. His cabinet, however, contained such men of ability as William L. Marcy, secretary of state; Jefferson Davis, secretary of war; and Caleb Cushing, attorney-general. It has the unique distinction of remaining unchanged throughout the administration.

In foreign affairs President Pierce's administra-

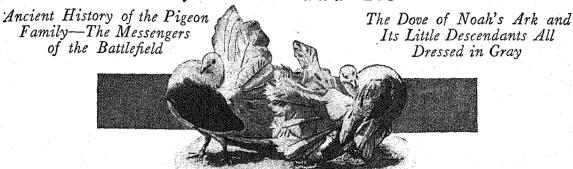
tion is notable for a treaty concluded in 1854 by Commodore Perry with Japan, opening Japanese ports to American vessels (see Japan). By the purchase from Mexico, in 1853, of a strip of territory in southern Arizona (the Gadsden Purchase), the southern boundary of the country was rounded out.

The South was especially anxious to obtain more territory which could be made into slave states. This was the purpose of a notorious "filibustering" expedition against Nicaragua by William Walker, which sought to set up a government there under American rule (1855), and with this movement President Pierce sympathized. It was also the motive of the Ostend Manifesto, signed by the United States ministers to France, Spain, and Great Britain, meeting at Ostend, Belgium, which declared that if Spain would not sell Cuba, the United States would take it by force. This declaration was condemned by most of the people of the United States. After completing his term, Pierce remained in retirement until his death in 1869.



Know-Nothing Party at its height (1854-55). Kansas-Nebraska Bill passed (1854). Filibustering Expedition to Nicaragua (1855). Border War in Kansas; John Brown and the Battle of Ossawatomie (1856). Brooks' Assault on Sumner (1856). Birth of Republican Party (1856).

The BIRD of PEACE and Its RELATIVES



PIGEONS AND DOVES. Two billion pigeons in one flock is a big bird story but nevertheless a true one. Less than a century ago such a sight was common throughout North America; for the wild passenger pigeon (or wood pigeon) was often seen in flocks 200 miles long, and it was found nesting in such enormous numbers that, over a 150,000-acre tract of forest, 50 to 100 nests could be counted in a single tree. It is said that the noise of these flocks could be heard for a distance of three miles, and that thick branches often broke with the weight of the roosting birds.

Now, however, there is not a single living specimen of the passenger pigeon anywhere in the world. A prize of \$1,000, offered for a pair of living birds of this species, remained unclaimed for years. The last of the captive passenger pigeons died—an old, old bird—in the zoölogical garden of Cincinnati in 1914.

The passenger pigeon was about 17 inches long from tip to tail, and of a bluish gray color above and reddish faun below. From this under-color it was frequently called the red-breasted pigeon. Its wings and tail were long and pointed, giving it a neat tailored appearance. It fed upon fruits, seeds and grain, and nuts.

The sudden disappearance of the passenger pigeon is regarded by many as a mystery. It is easily understood when the reckless slaughter is considered, to which it was exposed as the country became more thickly settled in the middle of the 19th century. Firearms could do in one generation what the bow and arrow had left undone for centuries. One shot from a modern shotgun, fired into a pigeon tree, would bring down enough pigeons to fill a game bag. Yet, not satisfied even with this wholesale killing, fowlers set large nets which sometimes took from 200 to 250 birds at one haul. The young just out of the nest, called "squabs," were especially marketable. for they were tender and toothsome.

Expert pigeoners followed the flocks from voosting place to roosting place, tracing their whereabouts by telegraph, and overtaking them by railroad.

The last recorded great nesting and slaughter in the United States occurred in Petoskey, Mich., in the year 1878. It is said that from this nesting-place tons of birds were sent to the New York market, and that it took 15 tons of ice to pack the squabs alone.

For 25 years following this raid, flocks were occasionally seen in various parts of the United States. But they were in ever diminishing numbers, and they were ever relentlessly pursued until their extermination became complete.

The pigeon family has an ancient history. The names "pigeon" and "dove" are used almost interchangeably; the former comes from the French and Italian (from the Latin pipio), while the name "dove" is akin to the Dutch duif. Commonly—but not always—the smaller members of the group are called "doves" and the larger ones "pigeons."

To this family belongs the famous dove of Noah's Ark. This bird must have been held in high regard by the early Hebrews, for it is recorded that the poor were permitted to substitute turtle doves for sacrifice, in place of lambs.

The American turtle dove, which is akin to the European species and is also known as the mourning dove, is well known in most parts of the United States. Its soft gray plumage with a collar of changing amber lights, its sad little cooing call, and its quiet friendly habits endear it to all. (For illustration in colors, see Birds.)

The Many Species of Pigeons and Doves

More than 650 wild species of pigeons and doves are known throughout the world. They are most numerous in the Eastern Hemisphere. The birds vary greatly in their habits. Some build in trees, others on the ground; some nest in isolated pairs, others in colonies. In drinking they do not lift the head as most other birds do, but take the water in long drafts. The pairs are said to mate for life. Both parents take turns in incubating the eggs, which usually number two, and nourish the helpless young on partly digested food mixed with a secretion from the crop. This food is called "pigeon milk." About 12 species occur in North America.

Pigeons were early tamed, and domestic pigeons are now common throughout the world. Three thousand years before the birth of Christ, the Egyp-

KID THE PLAN

tians raised pigeons for food, and probably used them also to carry messages.

The 150 or more named varieties of domestic pigeons, in spite of their great differences, have all been traced to the common ancestry of the wild rockdove of Europe and North Africa. This fact was made known by the great scientist, Darwin, who, in developing his theory of "natural selection," found the pigeon one of his most plastic subjects for experimentation. He discovered that triple crosses between

distinct varieties, of no matter what color, were very likely to produce, in the third generation, a color pattern precisely like that of the wild rockdove, which wears a plumage of grayish-blue color with white on the lower back and two black bars on the wings.

Domestic pigeons are divided into four principal groups. The pouters are a very distinct race, having an esophagus and crop that can be enormously inflated. A second group-having large feet, a long beak, and a rough wattled skin about the eyes—includes the carriers, dragons, runts, and barbs. Another group, with short beaks and naked skin about the eyes, includes the fantails, turbits, tumblers, and frill-backs. Finally there are those that more nearly resemble the rock-dovetrumpeters, laughers, nuns, spots, and swallows. Next to the pouter, the fantail differs

most from its original family, for it has from 36 to 46 quills in the tail, whereas the common rock-dove has but 12.

A carrier is a decorative pigeon raised mainly for show purposes. Pigeons bred and trained for racing or for carrying messages are termed homing pigeons. They possess a remarkable sense of direction and can be trusted to return several hundred miles to their home lofts. Caesar used pigeons as messengers during his Gallic wars, and the Saracens had a well-established pigeon postal service at the time of the Crusades. Thousands of "homers" are kept by clubs in America, and even more in Belgium, for the sport of pigeon racing, A speed of 60 miles an hour over a course of 75 miles is not uncommon; 40 miles an hour is considered good speed over distances of 125 miles or more.

During the first World War, where telephone and radio communication were not possible, the services of these feathered messengers won for them the praise and admiration of the world. All the armies made use of them. At one point 12 miles behind the

French lines, the British kept 60 pigeons housed in a London motor-bus. The outside had been roofed to form their cage, while the attendants, consisting of a chauffeur, trainer, and orderly, slept inside. A perch was cleverly arranged before the opening in the front, so that when the birds alighted on returning from their flight, an electric bell aroused the men inside, day or night.

The pigeons were taken out to the trenches in baskets to serve as needed. If not used in 24 hours,

they were released anyway with some message, to keep them in practise. Birds were always sent in couples with the same message, so that if one happened to be killed. there would still be a chance of the message arriving safely. An American pigeon, Cher Ami. brought help to the famous Lost Battalion of the 77th Division. Although seriously wounded when flying over the enemy firing line, he never wavered in his flight. When he died, his body was mounted and placed in the National Museum in Washington, D. C.

More than 450,000 pigeons were in use by the armies at the close of the World War. The United States Army Signal Corps maintains a pigeon breeding and training center at Fort Monmouth, N. J., and has active pigeon lofts at a number of other posts. In peace time these birds are much used by the

air service to establish communication in case of forced landings, especially in such regions as the Canal Zone, and the Hawaiian and Philippine Islands. Even the best of homers do not fly after dark, but the army is successfully developing a new race of night-flying homing pigeons that are vastly more useful as messengers in peace or war.

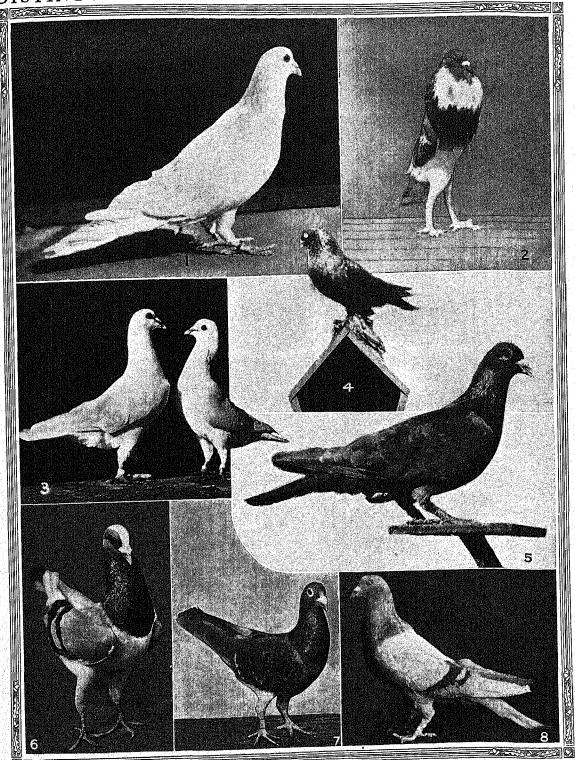
The raising of pigeons for food is common in Europe and America. The squabs, or young birds, when four weeks old, bring high prices in all markets. Pigeon nature demands sociability, and boys or girls who own a pair of pet pigeons often find that the birds will desert their private apartment for the crowded loft of a neighbor. Aside from providing salt, and water for bathing, the care of pigeons is similar to that of other feathered pets (see Pets and Their Care).

Pigeons and doves make up the order Columbiformes. Scientific name of passenger pigeon, Ectopistes migratorius; of mourning dove, Zenaidura macroura; of rock-dove, Columba livia livia.



The Maltese or "Hen Pigeon" is a very proud and showy bird. These birds always attract much attention at pigeon shows because of their peculiar carriage.

DISTINGUISHED MEMBERS OF THE PIGEON FAMILY



The White Swiss Mondaine (1) is used principally for squab breeding. The Red English Pouter (2) often "pouts," or inflates his trop with air, so vigorously that he falls over backward. The White King (3) is an excellent squab producer. The Black Muffed trop with air, so vigorously that he falls over backward. The White King (3) is an excellent squab producer. The Black Muffed trop with air, so vigorously that he falls over backward. The Red Carneau (5) is favored as a squab breeder. Tumbler (4) doesn't "tumble." He merely belongs to the Tumbler family. The Red Carneau (5) is favored as a squab breeder. Tumbler (4) doesn't "tumble." He merely belongs to the Tumbler family. The Red Carneau (5) is favored as a squab breeder. Tumbler (6) is noted for his beautiful markings. The Racing Homer (7) is famous ror flying exploits, both in peace The Hungarian Pigeon (6) is noted for his beautiful markings. The Racing Homer (7) is famous ror flying exploits, both in peace The Hungarian Pigeon (6) is noted for his beautiful markings. The Racing Homer (7) is famous ror flying exploits, both in peace The Hungarian Pigeon (6) is noted for his beautiful markings. The Racing Homer (7) is famous ror flying exploits, both in peace The Hungarian Pigeon (6) is noted for his beautiful markings. The Racing Homer (7) is famous ror flying exploits, both in peace The Hungarian Pigeon (6) is noted for his beautiful markings. The Racing Homer (7) is famous ror flying exploits, both in peace The Hungarian Pigeon (6) is noted for his beautiful markings. The Racing Homer (7) is famous ror flying exploits, both in peace The Hungarian Pigeon (6) is noted for his beautiful markings.

PIGMIES AT HOME IN THE CONGO JUNGLE



A group of pigmies of the Ituri Forest pose with a neighbor of normal size. Leaves cover the dome-shaped dwelling and furnish material for skirts. The belt and caps were probably gifts of Mrs. Delia Akeley, who took the picture.

PIGMY. Deep in the farthest reaches of hot jungles in Africa and the East Indies are strange races of little men so wild that they live almost like beasts. No one can be sure what kind of people they really are, or whence they came. Scientists generally place all pigmy types in the Negroid group of mankind, but they differ in their opinions about the origin and relationship of the pigmy stock. Some think that they may be racially the same as their larger neighbors; others suggest that the pigmies all come from one primitive stock different from any other race now on earth.

The term pigmy is from the Greek word pygme, meaning "fist," which was used to indicate a measurement of 131/2 inches. Most pigmies are a little over four of these units in height. These small people are not stunted or deformed members of the larger races. Physically and mentally they are rather like children. Their heads are large in proportion to their bodies, and their torsos are long and mounted on short, spindly legs. Though they are quick to understand, they are unable to concentrate. They are cheerful but highly emotional, and so shy that they are a curiosity even to most of their neighbors.

The African pigmies, known as negrillos, live in the dense forests of equatorial Africa. Best known are the Akka, or Tikki-Tikki, who live along the Ituri River in the Belgian Congo. The Asiatic pigmies, called negritos, include the Aeta of the Philippines, the Semang of the Malay Peninsula, the Tapiro of New Guinea, and the natives of the Andaman Islands

in the Bay of Bengal.

All over the world pigmies seem to live about alike, and to be on nearly the same level of intelligence. Although the men spend a great deal of their time in search of game, they live chiefly on wild fruits and vegetables. They disdain to do any real work beyond the actual gathering of food and the making of their few simple tools. They never plant or cultivate anything. Even their houses are flimsy structures of woven twigs and leaves that can be built anew each time the tribe moves. Their chief weapons, used almost entirely for hunting, are the bow and arrow, the blow-gun, and the knife; sometimes the arrows are poisoned. Clothing is a simple matter, since they usually wear nothing but breech-clouts or short skirts. Some tribes trade with their more civilized neighbors, exchanging forest products for knives, cloth, and ornaments.

Each small tribe is made up of a few family groups, and all work for the common good, for without whole-hearted cooperation they could not survive.

PIKE. Fish belonging to the pike family are ferocious in habits and appearance. They have undershot lower jaws, long narrow bodies, and only one fin on their backs. Their gray-green bodies with dark markings blend with the weed-grown waters along the shores of lakes and streams. There

they lie in wait, ready to strike at whatever moves their way. Some of their teeth are hinged so that they fold back while the fish is swallowing food. Though pikes are good to eat, they are regarded in some regions as pests because they destroy other game fish.

The largest member of the pike family and the mightiest of fresh-water game fish is the muskellunge. Specimens more than 5 feet long and weighing more than 65 pounds have been caught. Favorite fishing grounds are the waters of northern Wisconsin and Minnesota, and of western Ontario, particularly in the region of Lake of the Woods. There, in the shallows behind log or rock, the large "muskie" lurks, ready to catch passing fish, frogs, small water birds, or muskrats. It seizes the fisherman's bait more in savage resentment than from hunger. Once hooked, the great fish lunges, leaps out of the water, and frequently ends the fight by shaking the bait out of its mouth.

The common pike, also called northern pike, pickerel, jackfish, and many other names, abounds in northern North America, Europe, and Asia. It may weigh 40 pounds, but a 10-pound specimen is considered fairly large. Anglers frequently confuse a large pike with the muskellunge. The pike's cheek, however, in front of the gill covers, is completely overlaid with scales, whereas in the muskellunge the lower half of the cheek is bare. Smaller members of the pike family are called pickerel (little pike).

The so-called walleyed pike is a member of the perch family. It has two fins on its back, the front one very large, with sharp spines. The gar pike, with long, narrow jaws that resemble a bill, is not a true pike, but a member of the gar family.

Scientific name of common pike of Old World, Esox lucius; of New World, Esox estor. Of muskellunge, Esox masquinongy, or, as classified by some scientists, St. Lawrence muskellunge, Esox masquinongy; northern muskellunge, Esox immaculatus; Chautauqua muskellunge, Esox ohiensis. Of eastern pickerel, Esox niger; barred pickerel, Esox americanus; little pickerel, Esox vermiculatus. The last two are sometimes classified as varieties of the same species.

PILGRIMS. In the Middle Ages men and sometimes women often traveled long distances as pilgrims in order to visit spots made holy by their connection with the Christian religion. The tomb of Saint Thomas Becket at Canterbury, in England, and that of Saint James of Compostella, in Spain, were important places of pilgrimage; but the most renowned were the shrines of the apostles Peter and Paul in Rome, and the holy places of Palestine, connected with Christ's life on earth. Hope of healing for diseased bodies or souls, a love of adventure, and the desire to see new lands all sped the pilgrims on their way to the sacred places.

Pilgrims were under the special protection of the church. The marks of a pilgrim consisted of the broad-brimmed pilgrim's hat—usually adorned on the return with sea-shells and leaden medals of the saint—together with a staff, sack, and cup for drinking. Wealthier pilgrims rode horseback, and often traveled in considerable companies, as described in Chaucer's 'Canterbury Tales' (see Chaucer). The humbler sort traveled on foot. They lodged in monasteries or in separate "hostels" established for their aid, especially on the great Alpine passes, in the chief cities of Italy, and in Jerusalem. Pilgrims returning from Palestine usually carried palm leaves and hence were called "palmers."

Books were written as guides for the pilgrims, directing them as to their routes, and telling for example how much they should pay for their seapassage from Venice to the Holy Land, and of the preparations for the voyage. They must take with them a feather-bed, with pillows, sheets, and blankets; and they must take provisions for their private use, as well as necessary medicines. When they landed they must beware alike of foreign fruits and robbers. A list of phrases in foreign tongues was usually given, so that the pilgrim might ask his way and purchase necessary things. The stopping by the Seljuk Turks of pilgrimages to the Holy Land was one cause of the Crusades (see Crusades).

(For an account of the Pilgrim Fathers, who first settled Massachusetts, see the articles 'Mayflower' and Plymouth, Mass.)

PIN. A pin costs so little that we scarcely think it worth while to waste time picking one up, yet they were once so expensive that only the rich could afford them. The change has come about through the invention of machinery which can turn out pins in such enormous quantities that the cost of manufacture is only slightly greater than that of the brass wire from which they are made.

The world is practically supplied with pins made in the factories of the United States. It has been estimated that every man, woman, and child in the United States uses 125 pins every year. It is also estimated that only one pin out of every hundred is worn out or broken in use, the other 99 being lost and oxidized (rusted), and so returned to the soil from which the ore came.

The common pin is made of brass wire, coated with tin. From the time the wire is fed into the machine until the pins are stuck into the paper strips, ready for packing, the action is automatic. The wire is cut into proper lengths, the heads formed by a die, and the points ground—all without the touch of human hands. Then the pins are dipped in acid to clean them and receive a bright coat of metal by immersion in a solution of tin. Pushed along slowly until they have hardened, they drop into a revolving barrel of bran which cools and polishes them. They are then fed into a hopper with a steel plate at the bottom cut into slits just big enough to allow the body of the pins to fall down in them, but not the heads. Thus straightened out in rows, they move toward the edge and slide down an inclined plane. At the bottom of the inclined plane are the strips of paper, in which the pins are caught and inserted. The mechanism is so delicate that the least imperfection in one of the pins will stop the feeding until the obstruction is removed. One of these machines will stick 100,000 pins an hour. Hairpins, safety pins, and other kinds of pins are manufactured with similar machinery.

In the Egyptian tombs ornamented pins of brass, gold, and silver have been found, sometimes seven or eight inches long. Various species of thorn were often used as pins by early peoples. In Revolutionary times in the United States the heads of pins were made by twisting fine wire into a knob and soldering it firmly toone end. The first machine for making solid-headed pins out of a single piece of wire was invented by Lemuel W. Wright of New Hampshire in 1824.

PINE: Of all our forest trees the pines are among the most beautiful, the most numerous as to species, the most widely distributed, and the most useful to

mankind. They are practically confined to the Northern Hemisphere, and are common alike in Asia, Europe, and America. In size they range from a few feet in height to majestic species towering to 200 feet or more. They frequently form extensive forests scarcely mixed with other trees. A few species extend even into the tropics, these being found on the mountains of Central America. There are about 37 species in the United States alone, of which 25 occur in great forests of the western states.



The most common species in the United States is the white pine, a magnificent tree attaining a height of 80 to 175 feet. The branches, whorled horizontally about the splendid erect columns, are densely clothed in bluish green and gray needles, growing in small clusters of five needles each. The tree tapers gracefully and is very picturesque. It bears long slender

covered with orange-brown bark which separates into scaly plates. The cones are large and coarse. A veritable giant is the western yellow pine, often

The trunk is bare of limbs to a great height, and is

A veritable giant is the western yellow pine, often called the great yellow pine, which occasionally rises to a height of 230 feet and which frequently is 150 feet in height. The needles, which grow in clusters of

three, are long and twisted; the small oval cones have recurved prickles.

The loblolly pine covers great areas in the Southern states. It is very hardy and frequently springs up in devastated and impoverished land. It grows to a height of 80 to 90 feet and sometimes has a girth of six to eight feet. The needles are rather long, growing in groups of three, and are light green in color. The cones grow in pairs and are quite large.

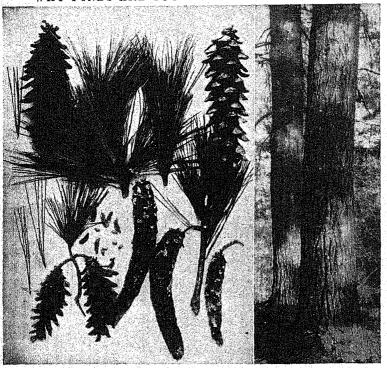
The Scotch pine, an important species introduced into America from northern Europe, has dark green needles growing in clusters of two, and small compact cones. The piñon or nut pine, found in the southwestern United States and Mexico, is a small tree with a bushy top. Its rounded cones produce large seeds which formed an important diet for the Indians.

Pines are valued for the durability and the attractive grain of their wood. They have long supplied most of the softwood lumber produced in the United States. The billions of board feet used each year for such purposes as beams, house frames, furniture, and interior finish come mainly from the various Southern pines, the west-

ern yellow pine, and the white pines. The more resinous of the Southern pines supply many industries with huge quantities of naval stores—resin, tar, and turpentine (see Turpentine). The Southern pines, notably the slash, the loblolly, the long-leafed Georgia, and the shortleaf, are important as a source of paper (see Paper). They have made the South the center of the coarse paper (kraft) industry, which annually produces containers and wrappers valued at many millions of dollars.

The Southern pines are coming into use also for the manufacture of newsprint paper, thanks to patient research by Charles H. Herty, a Georgia chemist. His discovery that young pines, which have no value for timber or resin, make satisfactory newsprint has given commercial importance to millions of wooded acres and has laid the foundation for a promising newsprint industry in the Southern states.

WHY PINES ARE SUCH MOUNTAIN CLIMBERS



"The pine trees," said John Muir, the famous naturalist, "march up in long, hopeful files, taking the ground and establishing themselves as soon as it is ready for them." Haven't you often wondered why pine trees are such mountain climbers? The picture tells you this, among other things. The two great trunks are those of the white pine, while in the group to the left are mature cones, clusters of needles, young cones, and the winged seeds, some with the wings detached. By their wings the seeds are carried with the wind up the mountain sides. It is really wonderful how little soll a pine tree can get along with, if its fortune is cast on some mass of mountain rock.

solitary cones which are slightly curved. The bark is greenish-gray and rather smooth on the younger trees, becoming rough and brown with age. The tree is a favorite with lumbermen because of its strong, clear-grained, easily worked wood, and consequently is much rarer than formerly.

The red or Norway pine is also a beautiful tree, having reddish brown bark from which it gains its common name. Though often attaining the height of the white pine, it is sometimes rather dwarfish. The branches are few and the needles, which grow in clusters of two, form sparse clumps at the ends of the short twigs. The appearance of the tree is rather light and airy. It bears small oval-conical cones.

The yellow pine or long-leafed Georgia pine is conspicuous for its needles, which are often a foot in length, growing in clusters of three. It is a very slender stately tree, rising to a height of 50 to 120 feet.

The true pines are readily distinguished from the spruces, firs, larches, and cedars by their foliage and cones. The leaves, which are evergreen, needle-shaped, and from a little more than an inch to more than a foot in length, usually grow in clusters of two to five, according to species, sheathed at the base by thin chafflike scales. The cones are pendulous and the woody cone-scales are thickened at the top.

Scientific name of the white pine, *Pinus strobus*; range, Newfoundland to Manitoba, along the Alleghenies south to Georgia. Red or Norway pine, *Pinus resinosa*; same range

as white pine. Southern yellow pine, Pinus palustris; North Carolina southward to Texas. Western yellow pine, Pinus ponderosa; British Columbia to Mexico and east to Nebraska and Texas. Loblolly pine, Pinus taeda. Scotch pine, Pinus sylvestris.

PINEAPPLE.
Once a rare table delicacy, the pineapple is now so extensively cultivated that it is one of our most familiar fruits.
It grows in many tropical lands; but the Hawaiian Islands, Cuba, and Porto Rico have made its cultivation

a specialized industry. In the United States it can be grown only in the parts of southern Florida which are most nearly free from frost.

As it stands in the field, growing out of a cluster of long sword-shaped leaves, the pineapple looks somewhat like a cactus. Each plant bears one fruit for the first crop. Later crops, which grow from sprouts (called "ratoons") on the stem below ground, generally yield two smaller fruits to the plant. When the fruit is "ruddy-ripe" the pickers armor themselves against the prickly leaves with thick gloves and leggings. As each picker cuts a "pine" he places it in a sack on his back and carries it to the end of the row, where it is placed in a crate.

Because the fruit bruises easily, it is hard to ship long distances; so nearly all the Hawaiian production is canned. Cuba and Porto Rico supply our fresh pineapples, mainly of the Red Spanish variety. As these are seldom fully ripe when shipped, they lack the rich flavor of the Hawaiian pineapple, which is usually the Smooth Cayenne variety.

Cultivated pineapples rarely produce seed. This is fortunate for the industry, since the fruit would otherwise be packed with a multitude of small hard seeds. The plants are usually grown from cuttings. These may be "slips," that grow in clusters near the base or

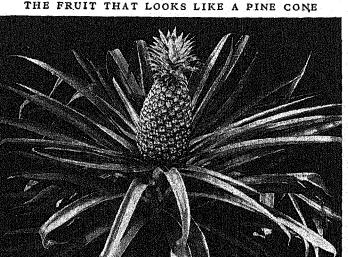
near the top of the fruit; "suckers," that develop in the axils, or pockets, of the leaves; or "crowns," the leafy tufts at the top of the fruit.

Though "pines" need little water and only fair soil, the land has to be heavily fertilized and the leaves are usually sprayed with sulphate of iron. Hawaiian planters lay strips of heavy asphalt mulching paper over the soil, and plant through the paper. This method is expensive, but it keeps down weeds, and conserves moisture and heat. The fruit ripens 14 to 22 months after planting. When the first crop is gath-

ered, Hawaiian growers usually leave two ratoons to each plant for the second crop. A third crop is produced in the same way, and then the land is plowed and allowed to "rest" before replanting.

What we call the "fruit" of the pine-apple is really a cluster of fruits, like the raspberry and the blackberry. Each "eye" in the horny outer rind is the product of one blossom.

The long tough leaves yield a valuable fiber which, in the Philippines, is woven into fabrics. The delicate and transparent



Porto Rico have Here is a Hawaiian pineapple, packed full of sweet pulp and juice. Notice its

Spanish moss.

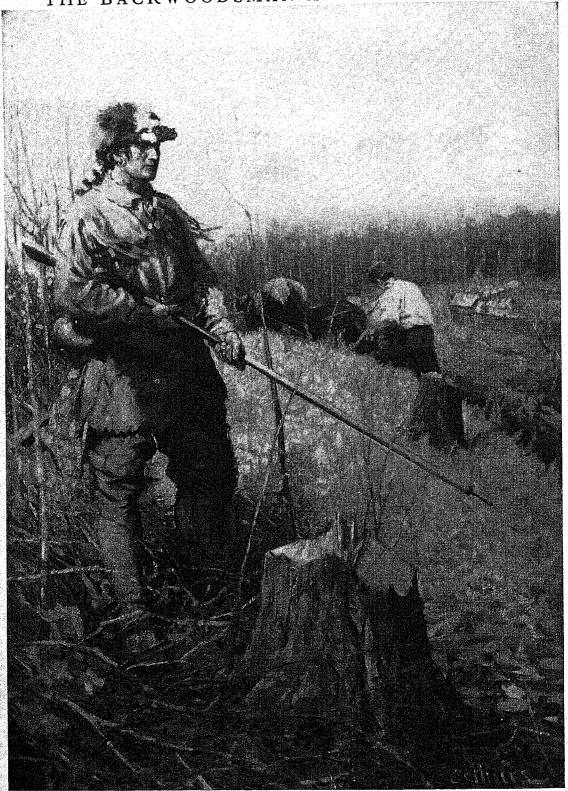
eloth known as piña is made from the finer fibers.

The pineapple (Ananas sativus) belongs to the pineapple family, the Bromeliaceae, which includes the bromelias and

PINK. Much of the spicy fragrance that hovers around old-fashioned gardens comes from the fringed-petaled flowers called the pinks. Among these is the clove pink, once called "Jove's flower," which is more familiar to us in its cultivated double-flowered form, the carnation (see Carnation). Another favorite is the sweet-william, whose gorgeous bunches of blossoms with markings of white and various tints of red are, as an old English flower book puts it, "worthy the respect of the Greatest Ladies who are Lovers of Flowers." Other familiar garden sights are the sweet smelling common pink with its grasslike leaves of gray-green and its pale pink and white petals that are always "spilling over," and the China pink, whose red blossoms with their strange markings bloom all summer long.

The pink is a genus (Dianthus) of the family Caryophyllaceae. The many species, mainly perennials, are natives chiefly of Europe, the Mediterranean lands, and temperate Asia. Its showy flowers, solitary or clustered, have jagged-edged petals, and narrow grasslike leaves. Some wild flowers of this family but not of this genus are also called pinks, among which is the fire-pink (Silene virginica), whose showy flowers of bright crimson bloom in early spring.

THE BACKWOODSMAN AND THE FARMER



The grim, watchful backwoodsman is ready with his Kentucky rifle for Indians. Meanwhile, the other man toils to make a farm out of newly cleared land. The fort and the stockade serve as refuge and shelter. Watch and work—these two activities formed the very essence of early pioneering in the United States. The picture is from a painting by Stanley M. Arthurs.

HARDSHIPS and HEROISM of PIONEER LIFE

HREE centuries ago, the American con-I tinent was a wilderness of forests, prairies, and mountains. Indians roamed everywhere: but probably the entire continent did not subport many more people than live now in Cleveland, Ohio. Today the United States alone supports about 130 million people, with a rich civilization. What produced this amazing change? Inventors, builders, and businessmen helped with many improvements; but their work rested on the foundations laid by the land-settling pioneers who kept pushing westward until they had turned the entire wilderness into a civilized land. Therefore, to understand the United States of today, we should understand these pioneers, their lives and struggles, and how they finally succeeded with their tremendous task.

How the pioneers started their work on the Atlantic coast is told in the article on American Colonies. Until the colonies won their independence from English rule, the people remained near the Atlantic; but when the United States won its freedom, it also won a vast forest wilderness to the westward. Then began the kind of pioneering about which this article tells.

PIONEER LIFE. When the American people started pushing west from the Atlantic coast into new lands, among the first to go were backwoodsmen from western Virginia and North Carolina. Daniel Boone had told them about fine land in Kentucky; and even before the American Revolution ended, some had started for this land.

A group of pioneers starting into the wilderness was a thrilling sight. In addition to women and children, a party usually included about 30 or 40 men and boys,

carrying rifles. Many fighters were needed because the Indians were not friendly, as they had been at first to hunters and trappers. They knew that the pioneers would make farms which would ruin the country for hunting. One group of riflemen marched ahead; the rest watched the live stock and guarded the rear.

Ahead of them lay the hardest kind of traveling, over rugged mountains and through thick forests. They had heard from Boone of a low pass over the mountains at Cumberland Gap; but the trees were so close that men could scarcely squeeze between. Vines, underbrush, and fallen trees added to the tangle. The only way to get through without chopping a path was to follow the Indian trails.

These trails began as animal trails. Even when the forests were young, deer and bison roamed over the land, seeking fresh pasture and avoiding winter cold. Instinctively the animals used the lowest passes over the mountains, and kept near water. Their hoofs beat down all growth along their lines of march, and so trails were kept open as the forest grew.



Equal partners with the men in work and danger were the pioneer women. Here the artist Gari Melchers has given us a superb study of such a woman gripping a mattack, or grub hoe—toil-worn but invincible.

Of course carts or wagons could not be used on such trails. Everything had to be carried on pack animals. Women and young children might ride these animals; but this added to the load and made the going slow. The party might march ten miles in a day, or even less if they had to chop away fallen timber from the path.

Late in the afternoon, the advance guard selected a good spot and made camp for the night. Some men kept watch, while others cut branches and built a windbreak. The women cooked supper. They made johnnycake by baking a batter of corn meal on a stone in front of the fire; they cooked venison or other game by broiling chunks held on sharpened sticks over the coals. After supper, the men posted sentries to watch the live stock and to give warning of Indians. Then the camp settled down to sleep, with the creakings and whispers of the forest for a lullaby.

Building a New Kentucky Home

Pushing forward slowly in this toilsome, dangerous fashion, the newcomers hoped to reach one of the little settlements already established by men like Boone. There they knew they would find a block-house fort, where everybody could take shelter if the Indians attacked. Without such a place of safety, none of them could hope to live through a season.

Day after day, they pressed on toward the fort. After a month or two of hard travel, they reached clay. He laid stones for a hearth, and built a chimney of sticks daubed thickly with clay.

The door and the window shutters were slabs of wood with deer-hide hinges. These could be kept closed by stout bars on the inside that swung at one end. To open the door from the outside, there was a

latchstring. This was a thong of deer hide attached to the bar and passed through a hole in the door Pulling it raised the bar so that the door could be opened. When troublesome Indians were about, the latchstring was pulled in at night; otherwise it was left out, so that neighbors could enter. Hence the saying, "the latchstring is always out," came to mean generous hospitality. There was no glass for the windows, but the openings were sometimes filled with greased paper or deerskin. This let some light into the cabin and kept out wind and insects.

When the owner found time, he made chairs and a bed; but most of the first season was spent in clearing land. He cut down and burned the trees. Between the stumps he planted corn, wheat, or buckwheat, and he cultivated the crops with a hoe. In most places the pioneer farmer could not plow

for several years. He had to wait for the roots of the stumps to rot so that they could be grubbed out.

LOG CABIN OF THE PIONEER TYPE

Although this log cabin in the Ozark Mountains was built in modern times, it shows the true ploneer method of building, with its dovetailed logs, its mud chinking, and its slab roof. The early Kentucky settler, of course, had no "store" lumber for his door or his window, nor did he have "store" clothing.

it. Then the men looked over the ground and drew lots for choice of land. Each man marked the boundaries of his claim by cutting his initials in trees.

All the men and older boys helped to build log cabins. For two or three days they cut trees into logs, and rolled the logs to the building site. The logs were cut about 20 feet long for the sides, and 16 feet long for the ends. Four big logs were placed on the ground for the foundation. The men notched the ends with axes and fitted them together. Next they laid a floor of stout poles crosswise between the longer logs. When the house was built, the owner covered the poles with roughly hewn slabs called puncheons.

More logs were laid and dovetailed at the corners until the walls were high enough. Then the builders laid crosswise poles for an attic floor. To start the roof they set up stout poles called rooftrees at each end of the cabin. Each pole had a Y-shaped fork, in which the ridgepole was laid. The men cut slabs from large trees, and laid them from the topmost side logs to the ridgepole. Across these slabs they laid poles and fastened them with wooden pegs, to hold the roof against wind.

Cutting openings for windows and a door finished the heavy work. The job was done in a week, or even less, if eight or more men helped. Later, the owner did his chinking—that is, he filled in the spaces or chinks between the logs with wooden chips, moss, and

The Early American Pioneers

How did these people learn to get along so well in the wildernesses of Kentucky and Tennessee? They learned from their parents and grandparents, who had been pioneers in western Virginia and North Carolina. That first wave of pioneers was made up of people who disliked conditions in the older settlements near the coast. They objected to government policies, they resented being thought inferior to the rich colonial merchants and landowners, and they wanted farms of their own. Though poor, they were daring and energetic. After about 1700, those early pioneers began to go to the western edges of the colonies to start a new life.

In all these pioneer settlements in forest lands, the people and their ways of living were much alike. To survive, they had to be strong and hardy. As a rule, they were quiet folk, who rarely expressed joy, sorrow, fear, or pride. But nothing in nature or the behavior of their fellow men escaped their keen notice. They had no money or salable property, so thefts were almost unknown. Every man trusted to his fists and his rifle to protect his rights, for it was long before law courts were set up.

Most of the pioneers were deeply religious, but they could not support ministers. So the older men took turns preaching on Sundays. At rare intervals a circuit rider, or traveling clergyman, might come by, preach on Sunday, and perform marriages and baptisms. These ministers might be paid a hundred dollars or so a year by the settlements along their circuits or regular paths. They were guests of each settlement in turn. So, too, were all travelers who came by; backwoodsmen, as these people were called, were insulted if anyone offered them money for a night's lodging.

Home Life in the Log Cabins

In such settlements, people had little use for money. Once a year or so they might trade furs and perhaps some farm produce for powder, lead, iron, and salt.

Their own gunsmiths and blacksmiths made their rifles and tools.

In the division of labor, every man, woman, and child shared fairly. The men and older boys provided the food by hunting and farming, chopped up trees for fuel, and made the furniture and household implements. For chairs, they merely stood hickory blocks on end. or made three-legged stools. Some of the slab tables had one side supported by the wall and the other held up by two sticks; others had four legs. The men made beds by laying slabs on a frame, and for mattresses the women stuffed sacks with chaff, moss, or pine needles. The men whittled out wooden forks and spoons, and made spinning wheels and looms. Women, girls,

and young children did the cooking and made soap, candles, and clothing. The boys "jerked" venison, by drying thin strips of the

meat before the fire or out in the hot sun. This prevented decay. The dried strips were hung in the attic until needed.

A broadax, of the type used by early pioneers for hewing logs into beams and

similar shapes.

The women made their own clothing of linsey-woolsey, a cloth they wove from flax and wool. They often dyed it yellow or brown with juice from butternut bark and husks. The men wore some linsey-woolsey, but they liked deerskin for outdoor clothes. They ornamented the seams and edges with colored fringe. Caps were made of raccoon skin, with the tail left hanging. When away from home everyone wore moccasins, but around the house the women and children frequently went barefoot.

The cabins never stood far from a stream or spring, because the women and children could not risk long trips through the perilous forest for water. The clearing around the cabin was their safeguard; it gave them a chance to see Indians or wild animals before they could get very close.

In good weather the newest baby was usually put outside the door in an Indian-style cradle. This was made of smooth wood and lined with pelts and a bit of blanket. Children had no toys; the parents could not spend time making such luxuries. Older children ground corn on a flat stone, with a round stone bound to a stick. They tended the small garden, planted with

squash, indigo, beans, flax, sorghum, and gourds. The gourds were used for cups and bottles; handles for the cups were made with twigs.

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Indoors, the from wife always kept



A typical cup of a pioneer family made from a long-stemmed gourd by a little trimming and hollowing out.

the fire burning. In summer, no other light was needed; the family rose before dawn and went to bed at dark. In winter, they burned rush lights, pine-knot torches, or tallow-dip candles. For special occasions some had waxy and sweet-smelling candles made of bayberries.

A bearskin rug lay before the hearth. Above the doorway was a pair of deer antlers. On these the family rifles lay when they were not in use. A powder horn hung from a prong. Near the guns, a mold for making bullets nestled between two logs.

The family had no sheets, no tablecloths, and no towels. They washed in a bucket, with strong, homemade soap; they bathed in a near-by stream or spring.

Food and Cooking

Until the family got vegetables from the garden and corn from the clearing, they lived on cow's milk, game, and berries. Sometimes the children grew so tired of

wild meat that they cried when it appeared on the table. Since wheat was too hard to grind without a regular mill, corn was the staple food.

Young, ripe corn was eaten as roasting ears. In winter the husks of the kernels were soaked off with lye to make hominy. For breakfast and supper there was boiled corn-meal mush. Sometimes the mush was fried and served with butter or



This bed, with its canopy frame and springs of criss-crossed rope, is typical of pioneer beds in the old Northwest.

pork drippings. The most common dish, however, was hot corn bread. Baked on a hoe blade before the fire, this was called *hoecake*. Mixed with water into a stiff batter and covered with hot ashes, it was ash cake. From the Dutch oven it emerged as corn pone or corn loaf. Small cakes of corn pone were called corn dodgers.

In time, chickens and eggs added a little variety to the menu. The most important meat animal was the hog. Coffee and tea were rare luxuries. Sometimes the mother made hot, coffee-like drinks of dried wheat, barley, or certain roots roasted and ground. Sugar was so scarce that it was used only for the sick or for a celebration. Instead the family used maple sugar, or wild honey, or sorghum sweetening. This last was sometimes called "long sweetenin"; it was black and thick and tasted slightly bitter.

Salt was expensive. It was usually packed on horses, and it sold for \$10.00 a barrel. Many families used no more than a pound of salt a year. Some got salt of poor quality from near-by salt licks. Pepper and other spices were practically unknown.

Life of the Pioneer Woman

The pioneer woman found life less interesting, more monotonous, and lonelier than did the man. Household tasks kept her indoors or near the house—cooking, cleaning, washing, mending, baking, spinning, and weaving. She had none of the conveniences that lighten the burden of household tasks today. For example, she had to make her own broom out of corn husks, or by shredding a hickory pole, fiber by fiber, until the brush at the lower end was fairly fine. Then she bound the fibers together with hickory splints.

The women also did most of the doctoring and nursing. They could probe for a bullet with some skill, trim a wound with a knife, and sew the edges together. They dressed wounds with a salve made of pounded slippery elm bark, and with bear's grease. They knocked out bad teeth with a hammer and a chisel. Almost every mother could help at childbirth, for doctors could not be had.

When a boy was 14 he was considered grown, and his father gave him a rifle. Most young people were married when not much older. Children got whatever schooling they had from their mothers and aunts.

Settlers in the Old Northwest Territory

PIONEERS DID NOT settle north of the Ohio River as soon as they did in Kentucky and Tennessee, for several reasons. Many of the

early pioneers went no farther than the fertile valleys of the mountains in the East and New England's new shipping trade gave work to many men who might otherwise have moved to the West. Besides, several states claimed the northwest region, and so settlers hesitated to take up land until they knew what authority would give them titles.

In 1787, however, the Continental Congress created the Northwest Territory, to include all land north of the Ohio and west of Pennsylvania, and encouraged settlers to move in (see Northwest Territory; Lands, Public). Immediately a flood of settlers began pouring in from the northern states, and from Maryland and Virginia.

Not many of these settlers were experienced backwoodsmen, like the people who settled Kentucky and Tennessee. Though most of them were country folk, who knew how to build a log cabin, clear land, and make their own clothing, they were not content with the prospect of living as pioneers all their lives.

Back home they had become accustomed to selling some of their crops for money, and they had been used to wagons and roads. Most of them brought a few cherished possessions—a small chest of "party clothes" for the women and girls, perhaps a "Sunday suit" for the father, dishes, and possibly even a four-poster string bed.

The journey into the Northwest Territory was a little easier than the trip into Kentucky, because the settlers could travel part way by water. People from New England and New York could cross northern New York and then sail along Lake Erie until they reached one of the lake towns or trading posts. People from farther south reached the Ohio at Pittsburgh, then used the river.

Early Boats on the Ohio

For two-way travel on the river they used dugout canoes, keel boats, and flat-bottomed batteaus, as they had on eastern rivers. But most of the newcomers built or bought boxlike arks or flatboats and drifted downstream. These craft could be steered and worked in to a landing with long oars, called sweeps, if the current was not too strong. But often strong currents spun them about like corks, or carried them past their landings.

Another danger was the Indians, until they were pacified by the Treaty of Fort Greenville in 1795. Many an ark went down the river like a floating fort, with rifles blazing through portholes at redskins along the shore. White pirates also plundered boats and killed people, until the Kentucky militia cleared them out at Cave-In Rock, below Shawneetown, Ill. After that, the worst danger was from snags or from drifting trees which had caught fast on the bottom.

Despite these dangers, the pioneers had a great deal of fun on these river trips. Sometimes the boys might fish, while the women busied themselves with cooking and mending or knitting. When the day's work was done, some member of the party might produce a fiddle and they would end the day with singing and dancing.

Trading Problems in Early Days

After these settlers arrived on their land, their life for the first few years was much the same as early life in Kentucky. They had to build cabins, clear land, and hunt or fish to add to their scanty food supplies. To get money, they floated grain, salt pork, and other products downstream to markets along the lower Mississippi. They either walked back or *poled* a boat.

To pole a boat, the men started at the bow of the boat and pushed iron-tipped poles into the bottom of the river. Then they walked to the stern, pushing as they walked. This way of travel was slower than walking, but it enabled them to carry supplies back home.

Supplies could also be bought from peddlers with pack animals. Settlers near the Ohio could buy from

TRAVELING DOWN STREAM IN A BROADHORN



Here a group of pioneers, with their goods and live stock, is drifting down a western river toward a new home. The men and older boys work the steering sweeps, while the women care for the children and live stock or watch the scenery from the roof. The boat is of the flatboat type; but it was called a "broadhorn" when it had steering sweeps at the sides.

boats that plied up and down the river. They were fitted up and stocked like country stores, with cloth, crockery, pins, tinware, hats, and other "store goods."

Cooperation in the Northwest

Pioneers came to the Northwest Territory in greater numbers than to Kentucky, and the northern settlements were larger. As a result, there was even more coöperation between neighbors here. When a new settler came, the neighbors helped him build his log cabin by a "house-raising" party. Later they had a "log-rolling" party to help him clear his land. The women had quilting bees and other gatherings, as the women had had in Colonial times. But the greatest coöperative effort came at harvest time. At break of day the harvesting crew assembled with scythes or cradles. At the word of the leader they started to cut, advancing in rows and working until the leader gave the word to rest or until they had to whet their blades.

After the small-grain harvest came the corn harvest. The corn was cut by hand with a long knife and stacked in shocks. Later the ears were husked, or stripped of their covering, at a husking bee. The men worked in two teams. They laid a pole along the pile to be husked, and the crews started at opposite ends. The teams joked and played tricks on each other as they husked, while the women and children cheered. The winners celebrated by carrying their captain around the yard, singing and yelling as they went.

Amusements and Celebrations

After a house-raising or a husking bee or any of the many other "bees" for cooperative work, there was usually a "social" for all—men, women and children. First they ate a huge supper. Then, as the flames of a great log fire flared up, the fiddler tuned up, and the

people began to dance. The star dancer or couple would execute a jig or a buck and wing to the accompaniment of clapping hands and stamping feet. Couples formed into sets for a square dance, under directions from a caller. The fiddler had the privilege of taking the prettiest girl to supper.

Similar celebrations were held for weddings and christenings. People came long distances, dressed in their best. When they neared the host's house, they bathed their feet in a stream and put on their shoes.

When no celebrations were being held, the people welcomed any wandering peddler or fiddler, or any stranger who could tell a good tale (see Appleseed, Johnny). The young men delighted in contests of strength. After a week of hard labor they often spent Sundays and holidays broad jumping, vaulting, running, lifting, wrestling, and boxing. Horse racing, cockfighting, and shooting matches were other amusements.

The Evil Side of Frontier Life

These sturdy pioneers had many difficulties to face, in addition to their struggle to make a living. Many troubles grew out of the government method of selling land. For many years, the land offices were in the East. A settler either had to buy before he started West, or he had to go West to select his land and then come back to buy. This opened the way for speculators to buy huge tracts of good land and hold it for stiff prices, and also made possible many frauds. The government at first sold its public lands at a minimum of \$2.00 an acre. After 1820 it lowered the price to \$1.25.

Many a settler, having spent his money for supposedly good land near a growing town, arrived with his family to find that his land was in a malaria-ridden swamp, or even under water. Strangely enough, such



swindles were not condemned by public opinion, or punished by the courts. Although most of the pioneers were honest in their own dealings, they were "Yankee traders" at heart, and admired anyone who got the better of a business deal. They thought that land sharpers, shyster lawyers, and even counterfeiters were "cute" and "smart."

Charles Dickens, in his novel 'Martin Chuzzlewit', describes a fever-ridden and ruined victim of a land swindle, who nevertheless laughed at an Englishman for being taken in. The pioneer remarked that the swindler "was a smart man, and had draw'd a lot of British capital that way, as sure as sun-up." The United States was to suffer heavily, and still suffers, in business, public affairs, and administration of the law, from this pioneer admiration for winning out, no matter how.

Rough-and-Ready Justice, Courts, and Law

The pioneers looked to their fists and weapons more than they did to courts and laws for protection of their rights. Fights were common in towns and in community gatherings. They were even regarded as sport. One English traveler wrote: "America is the country where life is held cheaper than anywhere else.... When men fight in the States they fight in earnest.... Revolvers are forever revolving. There is no objection to fowling pieces, to rifles, to bowie knives." A story is told of a prisoner in a frontier jail who offered to fight all comers, if he could go free upon beating every opponent; the community is said to have accepted the offer as thoroughly fair and proper.

John Reynolds, in 'My Own Time', tells of roughand-ready ways in the early courts. When he was about to open a session in one court, the sheriff, astride a bench, called out: "Boys, the Court is now open; John is on the bench." An Illinois observer tells how a certain judge responded to the lawyers' appeal to instruct the jury. "Why, gentlemen," he said, rubbing his head, "the jury understand the case; they need no instruction. No doubt they will do justice between the parties."

Court sessions were often held in a log cabin or a schoolhouse or a tavern. Lawyers and judges "rode the circuit" together. Their fees were ridiculously low; but they did not expect to make a fortune out of practising law. They used their profession as a means of getting ahead in politics and finally being elected to the state legislature or the national Congress. By riding the circuit, and proving themselves "smart" in court, they won friends among the voters.

New Frontier Beyond the Mississippi By 1840 Most of the good land north of the Ohio and east of the Mississippi had been settled. The regions beyond these rivers called

for a different type of pioneering. The prairies of the West seemed utterly unfit for farming to the men of that day. A country which had no trees, except for cottonwoods along the river bottoms, seemed to them a country too dry for crops. Geographies as late as 1870 labeled the region east of the Rockies "the Great American Desert."

The Indians, too, were an obstacle to settlement. The government had agreed that this land was theirs, and that no white man could enter without their permission, except to travel over certain routes, such as the Santa Fe Trail. The Indians threatened to fight rather than admit settlers. The only white men in the region were fur trappers and traders. Some of them lived here because they liked the open, wild life; but many were criminals who dared not return to the East.

The Covered-Wagon Rush to the Pacific

This indifference to the West changed in the winter of 1842-43, when Congress discussed a bill to provide land for settlers in Oregon. In the spring of 1843 a great rush to Oregon set in. This rush was different from any earlier pioneer movement.

The earlier migrations had been over cramped forest trails with pack animals or along rivers, such as the Ohio. But here no river between the Missouri and the Columbia would take a boat larger than a light canoe. Instead of forest trails, the pioneers had a broad, flat prairie for much of the way, and they could use covered wagons or prairie schooners, which developed from the Conestoga freight wagons used in the East.

Without wagons they could not have made the long journey, for they had to carry supplies enough for several months, as well as weapons and tools. A common list of supplies for one person was 150 pounds of bacon, a barrel of flour, a half-bushel of beans, 10 pounds of rice, 20 pounds of coffee, 20 pounds of sugar, a year's supply of cloth, 2 blankets, 4 pounds of gunpowder, and 12 pounds of lead for bullets. The wagons carried the women and children and this made travel faster. By drawing the wagons together in a ring at night, the pioneers had a good defense against Indian attacks.

Marching in Caravans with Covered Wagons

To make the most of these advantages, settlers organized caravans of from 20 to 100 wagons, and maintained something like army discipline, with a captain and other officers. The following account of a typical day is condensed from a description by Jesse Applegate, a captain who led a group in 1843:

It is four o'clock A.M.; the sentinels on duty have discharged their rifles and every wagon and tent is pouring forth its night tenants. Slow kindling smokes begin largely to rise and float away in the morning air. Sixty men start from the corral, spreading . . . through the vast herd of cattle and horses that make a semicircle around the encampment, the most distant perhaps two miles away.

By five o'clock... the teamsters are busy selecting their teams and driving them inside the corral to be yoked.... From six to seven o'clock is a busy time; breakfast is to be eaten, the tents struck, the wagons loaded and the teams yoked.... All know that at seven o'clock, when the signal to march sounds, those not ready to take their places in the line of march must fall into the dusty rear for the day.

It is within ten minutes of seven.... The pilot, a borderer who has been chosen for his experience in travel through roadless wastes, stands ready in the midst of his pioneers and aids, to mount and lead the way. Ten or fifteen young men are ready to start on a buffalo hunt. The cow drivers are hastening to the rear of their charge, for the day's march.

HOW THE COVERED WAGONS CROSSED PRAIRIE RIVERS



Perhaps the most back-breaking work during the entire journey to Oregon or California was crossing rivers and streams. Men and animals strained to the utmost, as we see them doing here; and often an entire day was spent in getting a caravan across.

It is on the stroke of seven. The clear notes of a trumpet sound in front; the leading divisions of the wagons move out; the rest fall into their places with the precision of clockwork.

The pilot [selects] the nooning place as nearly as the requisite grass and water can be had at the end of five hours' travel of the wagons. Today. . . . he and his pioneers are at the nooning place an hour in advance of the wagons preparing convenient watering places for the animals, and digging little wells near the bank of the Platte. A corral is not formed at noon. The wagons are drawn up in columns, four abreast

The sun is now getting low in the west, and the pilot is standing ready to conduct the train in the circle which he has previously measured and marked out. The leading wagons follow him; each wagon follows, the rear closing on the front, until its tongue and ox chains will reach perfectly from one to the other; and so accurate the measure and perfect the practice, that the hindmost wagon of the train always precisely closes the gateway. Within ten minutes the barricade is formed, the teams unyoked and driven out to pasture. Everyone is busy preparing fires to cook the evening meal, pitching tents and otherwise preparing for the night.

Crossing a Western Prairie River

In this way the pioneers marched day after day and week after week, except when they had to cross a river. In the prairie country the rivers are wide, shallow stretches of muddy water, flowing lazily over mud, sand bars, and gravel. Treacherous quicksand dots the bottom. Each bank is a slippery, cliff-like wall; it may be 10 feet high, or 50, except where side streams have cut a passage down to it.

Crossing such a river often was a terrific job. If the river bed was firm enough for wagons, the travelers were lucky. If it was not, they cut cottonwood branches and built a sort of mattress over the soft spots. Then they might have to let the wagons down the steep bank with ropes.

At the bottom, they tied a few wagons together, to give a hold on any that might stick in mud or quick-sand, or be carried away by the strong current. Ten or twenty teams were then hitched to the chain, and away the party went, with the animals splashing and tugging, and the men pushing and prying at the wheels with poles. In times of high water, the animals had to swim across, and the wagons were unloaded and floated across.

The Gold Rush of '49 and Mining Life

Four months, six months, or even more of such travel brought the train of covered wagons to its destination in the Far West. On the way, some people had died or had been killed by Indians; babies had been born. If crimes had been committed, elected leaders had tried the criminals and fixed punishment.

When the caravans reached Oregon, they were in forest land. There the settlers cleared farms just as in the Middle West. But in 1849 movement to the West took on a new character. Gold was found in California and immediately there was a tremendous rush to reach these new riches. This led to the wild, hard life of mining camps (see California; Far West).

Settling on the Prairie in Sod Houses

During the years of the gold rush nobody thought of the prairie country except as an obstacle to be erossed as quickly as possible. But after the Civil War several changes worked together to make people think of settling there. The low rates charged by the newly invented steamships had opened a vast market for American wheat and meat in Europe. Railroads were reaching west of the Missouri now, and could carry away such products. Much of the prairie land

was found to be good for wheat; and where the climate was too dry for wheat, cattle could be raised. These changes brought a rush of settlers to the prairies of Kansas, Nebraska, and the Dakotas. The article Cattle tells how the beef industry grew; here let us see howother pioneers struggled to start wheat farms.

Like all pioneers, these settlers had to make homes out of any material they had. In this treeless land, the only material was sod, the top layer of prairie earth that was held together by interlaced roots of tough prairie grass. The home builder

cut square chunks of sod with a spade and piled them up to make the walls of his home. For a roof he used a wooden frame covered with tar paper or old lumber. He bought good lumber for a door, if he could afford it.

To prepare the land, he needed a plow and work animals from the start to break up the tough sod. These pioneers had to clear the land rapidly in order to raise large crops of wheat and sell them so that they could buy the other necessities of life.

Since trees were scarce, they used dried buffalo droppings, called *chips*, for fuel. Early comers settled near streams, but all settlers tried to drill wells as soon as possible, to insure a water supply if the stream should run dry. Every settler also procured a windmill as soon as he could. Then the strong wind, which never ceases blowing over the open prairie, would pump the water for him.

Crop Failures and Lonely Lives

Settlers here depended from the start upon being able to sell crops. But the varying prairie weather made crop prospects a gamble every year. Some years were dry; then the crops seared in the fields, while the settlers baked in furnace heat. In other years the rains were plentiful, but a plague of grasshoppers would eat the wheat during the summer; or rust, smut, and other plant diseases would get into the crop. Good years came too; but all too often the money from good years was spent getting through the bad ones.

Another hardship was loneliness. Farther east, a man could make a living from a quarter section, or one-fourth of a square mile, of good land. Out here a full section was none too much. Hence the sod houses often stood several miles apart, with nothing between but waving grass or a sea of wheat. The only

towns consisted of a few stores and houses clustered around a grain elevator; and these towns were miles apart along the railroads. Many settlers, especially the women, went crazy from loneliness, hardship, and despair over bleak prospects. Winter was even more trying than summer. Howling blizzards swept the land, without even a tree to break their force, and

A LONELY SOD HOUSE ON THE WESTERN PLAINS



This Nebraska sod house is typical of the homes which pioneers built while they were establishing wheat farms on the western prairie. Many such houses were miserable hovels; but this one has frame windows and good lumber to support the roof.

buried everything under huge snowdrifts. Often the live stock perished, because the animals could not paw down through the snow to get dried grass, and the settler did not have feed enough to last through the winter. Many a person died because no doctor could get through the snow from the nearest town.

After years of such trials, the pluckier and more skilful settlers began to get ahead. They got windmills and machinery. In the eastern part of the prairie, the trees that had been planted made life pleasanter. The windbreaks planted west and north of the farmhouses helped to hold off snowdrifts in winter and provided shade in summer. The towns, too, had grown; and by the beginning of the 20th century, civilization was well established on the prairie.

Pioneer Settlements Become Civilized Communities THIS CONQUEST OF the prairie was the last largescale pioneering effort made within the United States. It

filled the last gap in the settlement of the country, and spread civilization in an unbroken chain from the Atlantic to the Pacific. But long before this was accomplished, two developments had brought the story of pioneer life farther east to a close. One of them was good transportation. The other was the growth of towns, where the settlers could trade and enjoy the benefits of community life.

Developing Good Transportation

In the early days east of the Mississippi, difficulties of transportation all but paralyzed trade. The only way settlers could haul crops overland to a city market was with animals. But the nearest city markets were hundreds of miles away, beyond the mountains. A journey to any of them would take weeks; and animals

could not haul loads big enough to pay for weeks of time. The same long expensive haul was required to bring in manufactured goods.

Settlers along the Ohio or connecting rivers could float good-sized loads downstream to market in arks and flatboats, but they had to spend months getting home, especially if they poled a boat upstream with supplies. They, therefore, could not hope to make much progress until transportation methods improved.

To meet this need Congress in 1806 authorized construction of the National Pike, or Cumberland Road, from Maryland to the Ohio River (see Roads and Streets). The National Pike reached Wheeling in 1816, and in 1825 the opening of the Erie Canal gave a good connection between New York City and the Great Lakes. Meanwhile, in 1811, the first steamboat had appeared upon the Ohio River. Others followed rapidly, and provided transportation along the Ohio and Mississippi, and later on the Missouri River.

These improvements in transportation opened the way to prosperity in the Middle West. In 1825, for example, the only markets for Cincinnati flour were local townspeople and the river-steamer trade. The price was about \$3.00 a barrel. In 1835 demand from eastern cities had raised the price to \$6.00 a barrel. In that year, the farmer got 32 cents a bushel for corn; formerly he had been lucky to get 12 cents. The quantities sold increased in even greater proportion.

The next improvement was the railroad, which reached regions far from the lakes and larger rivers. By 1850 good transportation was becoming available practically everywhere east of the Mississippi.

The pioneers west of the Mississippi had much less trouble with transportation. The first settlers on the Pacific coast had a hard time getting there; but once they had arrived, they could carry on trade with where towns and cities would grow was transportation. Towns' along the Ohio usually grew up at points where important natural trails reached the river, or where tributary rivers flowed into it. At such junctions, somebody would start a store, and someone else would open a tavern or inn, to accommodate travelers who had money to spend. Often a black-smith's shop, and usually a mill run by water power would be established. Mills were much in demand, because the settlers could not produce satisfactory flour for themselves from wheat. As soon as possible a school and churches were added.

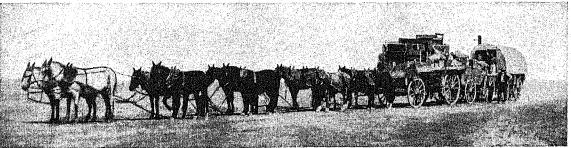
Towns and cities grew up similarly on the Great Lakes, at river mouths, and at trail ends. Away from the larger rivers and the Great Lakes, small inland towns got their start at fords across rivers, at branches and crossings of the main trails, or perhaps at the site of a flour mill. Whether or not they grew depended upon whether they had advantages for any activity other than service to the neighborhood.

Once good transportation became available and money came into the country, some of these communities grew rapidly, because they had splendid advantages as centers for trade. When suitable raw materials were at hand, factories appeared, to compete with the East in supplying the local market. The workmen created still more trade, and enlarged the market for the farmers.

Growth of Education and Communication

In the early years of settlement east of the Mississippi, no pioneer community could afford to spend money on schools and education. Whatever the children learned was taught them by their elders. The pioneers, however, did what they could to promote learning. They held spelling contests, called "spelldowns," and cherished any books they might own.

HAULING FREIGHT IN REGIONS NOT SERVED BY RAILROADS



Before railroad branch lines were built in the west, communities off the main lines were served by teams and wagons such as this "ten-horse drag." While on the road the freighter and perhaps his family lived in the "cooster" or "coaster" at the end of the drag. Some such arrangement was necessary, because a haul to a distant community might require a week or more.

eastern markets, in sailing vessels, and they could pay for eastern goods with newly mined gold. The prairie settlers never had a bad transportation problem, because the railroads were there ahead of them.

How Towns and Cities Got Their Start

The first towns west of the Appalachian Mountains grew up around the forts which provided protection from Indians. Detroit and Pittsburgh got their start this way. Later, the great factor which determined Many a boy, like Abraham Lincoln, got most of his early education from only one or two books.

After the land had been cleared and the struggle to get the necessaries became easier, the pioneers sometimes hired a schoolmaster and paid him "in kind"—that is, with his food, a home, and a tiny sum in money. The most important help, however, came from action by the national and state governments, which set aside land for the support of schools. As soon as settle-

ment made the land valuable, it was sold and the money, together with taxes, provided support for free public education (see Education).

Communication of news and transaction of business by letter were crippled at first, not only by lack of transportation, but also because the people could not pay for such services. News traveled largely by word of mouth, and travelers were welcome everywhere, because they could tell what was happening in other

parts of the world. As soon as steamboats appeared. good postal service was provided for all the communities they served. Then newspapers from the East put the settlers in touch with national and world affairs. Men also began publishing local newspapers, even before the communities could support such undertakings. Many of them did so for the same reason that lawyers rode the circuit—because the newspaper gave them power and influence in local and state politics.

of the Pioneers Historic Problems

THROUGHOUT history most pioneering efforts have consisted of three waves or phases. First, the new country was entered by explorers or exploring missionaries. Usually the explorers were followed by a mixed group of hunters, travelers, traders, and founders of mission settlements. Except for the missionaries, these men expected to stay only a short time, and then to return to civilization with whatever they had gained; but they stayed on the same ground longer than the explorers, and obtained more detailed knowledge of the region.

These two waves may be expected to enter any newly opened country almost immediately. Whether the third wave—the wave of pioneer settlers—ever will come depends largely upon conditions in the homeland. Explorers, hunters, and trappers need little incentive to plunge into the wilderness. Most of them enjoy the thrill of adventuring in new lands. But people of settled habits, like farmers, do not leave civilized surroundings unless some strong motive drives them. In the United States, this motive was largely land hunger -the desire to win a better living for themselves and their children, by taking up and farming new land.

Early agricultural methods had an exhausting effect on the land and many an eastern farm owner found his land producing less and less, until finally he had to abandon it. He then had to choose between starting over again as a laborer or going west into new country. Again, many families went pioneering because they disliked the restraints of civilized life. There were men who could cultivate land but who did not have the knack of trading shrewdly with buyers and merchants, and so could not get along in regions where most affairs were transacted with money.

Finally, the landseeking pioneers were always accompanied by a fringe of ne'er-do-wells, criminals, and sharpers, who expected to do well for themselves in a country where law and order were not yet established.

Problems of Land Ownership

Since desire to own land was the motive behind most American pioneering, the movement was profoundly affected by the policies of the national and state governments concerning land ownership. Fortunately, the governments encouraged settlement from the start. Also, throughout most of the 19th century, plenty of land was available; the governments therefore followed one of the most generous policies in history providing land for all who asked for it (see Lands,

Public). Nevertheless, many troublesome and heartbreaking problems often had to be solved before a settler's ownership was secure. Almost always the genuine settlers were preceded by a wave of squatters. men who occupied land without obtaining legal ownership. When the legal owner appeared, the squatter often refused to move; and in the early, lawless days, the rightful owner might have to fight for his land.

Such troubles were largely ended when the Homestead Act was passed in 1862. Thereafter, squatters could protect their interests by making entry, or declaring intention to acquire the land under the terms of the Act, at the time they occupied it.

Relations with the Indians

In addition to these problems of land ownership there was the danger from hostile Indians, which haunted the pioneers from the first almost to

the last. The Indians, for the most part, were friendly enough, so long as the whites were content to hunt, fish, and trap, but when the pioneers started to clear land, and thus drove away the game, there was trouble. Then the Indians fought, as any men would. to defend their lands and their source of livelihood.

This struggle began when the pioneers first entered Tennessee, Kentucky, and Ohio; and the weak national government under the Articles of Confederation could do nothing to protect them. After a new government was set up under the Constitution, it adopted an Indian policy which was to have tremendous effect, for both good and bad, upon the pioneers.

The United States assumed supreme authority over all the national territory. Under this supreme control, however, the various Indian tribes were considered separate nations, and the United States dealt with them by treaty, as it did with foreign nations. It recognized their rights to certain hunting grounds, and agreed that whites should stay out, except that they might use certain trails through the tribal land. The Natchez Road, the Michigan Road, and the Santa Fe Trail are examples of such "treaty" roads.

Broken Treaties, Frauds, and Wars

In this way, the government tried to deal fairly with the Indians; and throughout the 19th century, it took land from them only by treaty, with payment in money and supplies. As a rule, the Indians were willing to keep their agreements, and rarely took to the warpath unless they felt they had been wronged. Most MID DEPOSIT

Indian wars started because the government could not, or did not, compel the traders and pioneers to observe the treaties and deal honestly with the Indians.

The traders were the worst offenders. They sold Indians whisky, in defiance of the law. They sold other goods on credit at extravagant prices, and when the Indians brought in furs, the traders cheated in their accounts, so the Indians remained always in debt. When trouble followed, the whites would call for troops, and the Indians would be the losers. They had to surrender their hunting lands and move west of a new dividing line, before the government would agree to pay their debts. Thus they were gradually pushed off their ancestral lands. The entire Northwest Territory was cleared of Indians in this way; the last of them who occupied good farm land were packed off to the West after the Black Hawk War in 1832 (see Indians).

Andrew Jackson's Indian Policy

The tribes in the South, however, were too highly civilized and too intelligent to be thus victimized. During the presidency of Andrew Jackson, a brilliant new plan was devised for settling the Indian problem once and for all. West of the Missouri River lay the vast prairies which the white men believed they would never want. Here the Indians could live as they liked. The Cherokees, the most highly civilized nation, and other tribes were told, therefore, that the govern-

ment would give them prairie land, and they must move to it.

The Indians protested that this was a plain violation of their treaty rights. But after years of bickering and threats of war, they were moved to their new lands in 1839 and 1840. This was the beginning of the Indian Territory, which is now part of Oklahoma.

For many years, this policy proved fairly

successful. The whites complained constantly of the Indians' stealing; local fights occurred from time to time; but the Indians did not make a desperate last stand until railroads began to penetrate the prairies.

Indian Troubles in the West

Then the old story repeated itself. White hunters, such as Buffalo Bill, began to slaughter the bison wholesale, to provide meat for the construction camps; settlements and towns sprang up; white traders, gold seekers, and even settlers, poured into Indian lands. Years of savage warfare followed, until finally the government concentrated all the Indians on reservations, and the entire continent was open for white settlement. During all this century of trouble, the principal sufferers, of course, were the Indians and the settlers on isolated farms, for the traders, rail-

road builders, and townspeople usually had protection from the army. But the courage of the pioneers pulled them through this trial, as it did through all others; and so they completed their historic task.

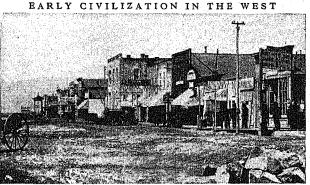
Pioneering in Modern Times

While the American pioneers were spreading farms and ranches over the country, the Dutch were pioneering in South Africa. British settlers were moving into the interior of Canada and Australia, and frontier communities were spreading in South America, especially in Argentina, Uruguay, and Paraguay.

In most of these regions pioneering is over, because today's settlers have every advantage of civilization at their command. But elsewhere pioneering continues, and the pioneering spirit lives on. One of the most astonishing pioneer movements of modern times is the Soviet government's development of the bleak arctic regions of Russia and Siberia. Today Canada, too, still has a pioneer fringe, in the Peace River country of the far Northwest. In many parts of Alaska, settlers are clearing land and establishing new homes. Most modern pioneers, however, are not homeseekers.

All over the world, for example, highly trained scientists and skilled explorers are searching wild lands for petroleum and other minerals. Other pioneers in science plunge into tropical wildernesses to study yellow fever and similar diseases; and many of them

have died at their work. There are also pioneers of the air-fliers who have blazed the way for airplane travel by trying out new airplanes and new routes. And there are pioneers in business-men who try out new ideas and new services and enrich life for us all. Thus has most pioneering shifted its objectives from the settling of new land. But as long as there are men who thrill to



For many years, such drab little towns as this were the western pioneer's only contact with civilized community life. A common device to make shacks look larger was a "false-front" second story.

the call of the new and the unknown, we shall have pioneering, whatever the objectives they seek.

Bibliography for Pioneer Life

-Books for Beginners:

Brink, C. R. Caddie Woodlawn (Macmillan, 1935).
Grey, Katharine. Rolling Wheels (Little, 1932).
Lenski, Lois. A-going to the Westward (Stokes, 1937).
McNeely, M. H. Jumping-off Place (Longmans, 1929).
Meader, S. W. Down the Big River (Harcourt, 1924).
Orton, H. F. Treasure in the Little Trunk (Stokes, 1932).
Skinner, C. L. Silent Scot, Frontier Scout (Macmillan, 1925).
Sperry, Armstrong. Wagons Westward (Winston, 1936).
Wilder, L. I. Little House in the Big Woods (Harper, 1932).

-Books for Advanced Students and Teachers:

Dick, E. D. The Sod-House Frontier, 1854–1890 (Appleton, 1937). Dunbar, Seymour. History of Travel in America (Tudor, 1937). Garland, Hamila. Son of the Middle Border (Macmillan, 1917). Miller, Joaquin. Overland in a Covered Wagon (Appleton, 1930). (See also the Bibliography for United States History.)

PIRATES AND PIRACY. Stories of pirates and buried treasure, of the "Jolly Roger," the black flag with the skull and cross-bones, of captains and crews "walking the plank," while the cut-throats of the Spanish Main sang terrible deep-sea songs to the time of waving cutlasses—such tales have been read and re-read by English and American children for generations. They usually end with the pirate chief hanging at the end of a ship's yard-arm, after his black band has been sent to "Davy Jones's locker" in a hot fight with a man-o'-war.

In these tales there is at once more and less than the truth. When history's microscope is turned on the pirate, he usually turns out to be a dismal villain without a trace of romance. He played on the high seas the same part that the bully leader of a sneaking band of thieves and murderers plays on land. On the other hand, pirates were by no means always punished or even discouraged in their lawless employment. Men of position and wealth at times provided them with ships and equipment in return for a share of the booty. Even governments sometimes gave secret support to adventurers whom we should regard as pirates, provided they attacked only enemy or neutral vessels.

The Rivalry of the Seas

To understand this attitude, one must realize the intense rivalry that existed on the seas during the 16th, 17th, and 18th centuries. Even when peace reigned on land, the ships of England, Spain, Holland, France, and Portugal continually struggled and fought to get the upper hand in the commerce with the West and East Indies and America. The assistance of rogue sea captains was not scorned in the contest, and it was an easy step for these shipmasters to turn from patriotic fighting to private buccaneering.

Piracy has existed since the earliest days of seafaring. From the times described in Homer's 'Odyssey' to the present days of occasional Malay raids in the China seas, the ocean has been looked upon by lawless men as a sort of watery "no man's land." In the earlier days, piracy was almost respectable, but when the great nations of Europe began to depend on their foreign commerce, international law declared it a crime against all mankind. Death was the usual penalty when caught. But despite severe measures to repress them, pirates continued to flourish so long as they could find a place of refuge and a market for their stolen goods.

Decatur and the Pirates

The last great den of what may be called "pirates" on the Barbary coast of northern Africa was attacked by Stephen Decatur in command of a United States fleet in 1815, and their power was broken (see Decatur). These Barbary corsairs, as they were called, had been protected for centuries by the native rulers of these wild shores. Organized piracy today has been wiped out everywhere except on the coast and rivers of China, where pirate bands in sailing junks still plunder small craft when opportunity offers.

Among the best-known pirates, besides Captain Kidd (see Kidd, Captain William), was Captain Avery, who was put to death in 1696. His adventures are said to have inspired Defoe's 'Life, Adventure, and Piracies of Captain Singleton'. Another famous freebooter was Bartholemew Roberts, the nearest approach in history to the pirate of romance. He was killed in battle off the coast of Africa in 1722.

Treasure hunters still dig along the coast of North Carolina seeking the loot supposed to have been buried by the notorious Capt. Edward Teach or Thatch, better known as "Blackbeard" because of his great black beard. Teach was killed in 1718 in a hand-to-hand battle with naval men from Virginia. Teach, an Englishman, had been a privateer in the War of Spanish Succession (1701–13).

No civilized nation ever recognized pirates, but "privateers," ships owned and operated by private citizens with commissions known as "letters of marque," were for centuries assigned to attack merchant ships or even war vessels of an enemy. Their reward was the vessels and merchandise they captured. Privateering was abolished in Europe in 1856 by the Declaration of Paris. The United States, whose privateers had been so successful in the War of 1812, refused to sign, but did abandon the practise. Among the most famous of privateers was Sir Francis Drake (see Drake, Sir Francis).

PISA $(p\bar{e}'z\bar{a})$, ITALY. The "leaning tower" of Pisa has done more to make this city on the Arno famous than all its stirring history, its noted paintings, and its other great buildings. Constructed entirely of white marble, with walls 13 feet thick at the base, the eight-storied tower rises 179 feet, about the height of a 15-story building. At the top it is $16\frac{1}{2}$ feet out of the perpendicular; in other words, a stone dropped from the lower side of the upper gallery would strike the ground $16\frac{1}{2}$ feet from the wall at the bottom of the tower.

A stairway of 300 steps built in the walls leads to the top, where a magnificent view of the city and of the sea, six miles away, is unfolded. The tower, intended as a bell-tower for the nearby cathedral, was begun in 1174 and finished in 1350. The foundations were laid in sand and it started to tip after the first three galleries had been built, but the work went on with slightly changed plans. Some engineers refer to it as the "falling tower" of Pisa, for it has tipped an additional foot in the last century. The scientist Galileo, who was born in Pisa, used the tower in experiments to determine the velocity of falling bodies (see Galileo). In the same square as the tower are the famous Pisa cathedral and baptistery, which like the tower are fine examples of Romanesque architecture; and the ancient city walls and citadel add interest to the city.

Relics of the days when Pisa was a Roman colony are preserved, but the city did not gain great historical importance until the depredations of the Saracens in the 11th century. The inhabitants not

only drove out this foe, but pursued him to Sicily and even to the shores of Africa. For some time afterward Pisa figured as a powerful and wealthy maritime city republic. It took an active part in the wars and

pull themselves up over shrubs through a tendril formed by the midrib of the leaf extending beyond the tip. On many of these tendrils are developed wonderful little pitchers standing upright with lids

THE LEANING TOWER AND CATHEDRAL OF PISA

The tower is one of the "Seven Wonders of the Modern World." For nearly six centuries it has been leaning away from the white marble cathedral. The view from its top, embracing the mountains and the sea, is superb.

politics of Italy for four centuries; at the height of its power, in the 12th century, it had a population of 150,000, a territory stretching along the coast from near Genoa almost to Rome, and dominion over Sardinia, Corsica, and the Balearic Islands.

Pisa's decline began with a defeat of the Pisan fleet by the Genoese in a great sea fight off Meloria (near Leghorn) in 1284. It was conquered by Florence in 1406, and thenceforth held in subjection by that state except for the brief period 1494–1509. Pisa was the scene of a great church council in 1409, which was called to settle rival claims to the papacy. As a part of the grand duchy of Tuscany, it was absorbed into the rising kingdom of Italy in 1859.

Commercially the town today has little importance. Cotton manufacture is the chief industry. It has a university, founded in 1338, which is still an important center of learning. Population, about 68,000.

PITCHER PLANTS. Some plants have turned insect catchers in order to supply themselves with nitrogenous food. The pitcher plants are the most noted of these. Many species of pitcher plants grow in tropical Asia and Borneo. They are climbers and

that stand enticingly open. Each pitcher is a trap. It has a stout sleek rim, which is curved inward and contains glands that give forth a sweet juice attractive to insects. Below the rim the inside of the pitcher is very smooth, so that visiting insects falling over the rim slide down in spite of their efforts. In the lower part of the pitcher are glands that secrete digestive fluid, which partially fills the pitcher. The rim and the cover of the pitcher are blotched with red, to attract the insects which come eagerly to sip the sweets. These possibly act as intoxicants, since many usually wary insects fall into the fluid and are digested; for the plant literally eats them.

The pitcher plants of America, often

called "side-saddle" plants, grow in swampy places, the leaves being arranged in a circle about the root. Each leaf is a pitcher with a broad flattened lid, in color green blotched with purple, the lid and the mouth being brighter colored. Each pitcher has a wing along the inner side, marking the "seam" where the edges of the leaf join to form the pitcher, and this wing has glands which secrete nectar; also the rim and the under side of the lid have similar glands. Thus a path of joy is prepared for the visiting insect, along which he may crawl up the side and over the edge. The inside of the pitcher is not only smooth but has downward-pointing hairs-so down the greedy visitor falls into the fluid at the bottom of the pitcher, where it is speedily drowned and decomposed. The manner in which the insects are actually digested and absorbed by the plant is not yet known. In California there is a huge pitcher plant that has pitchers three feet high. The side-saddle plant belongs to the genus Sarracenia; those with the pitchers at the tip of the tendrils belong to the genus Nepenthes. (For illustration see Plant Life. See also Sundew; Venus' Fly-Trap.)

PITT, WILLIAM, THE YOUNGER (1759-1806). "It's not a chip of the old block; it is the old block itself," enthusiastically exclaimed the orator and statesman Edmund Burke, after listening to the first speech in Parliament of William Pitt the younger, the second son of the great Earl of Chatham (see Chatham.

William Pitt, Earl of). And when someone else declared that, "Pitt will be one of the first men in Parliament," the Whig leader, Charles James Fox, replied, "He is so already."

All this praise was given to a young man only 21 years old, an age when many young men are still in college. But William Pitt had "an old head on young shoulders." Indeed, his friends used to say that he had never been a boy. He was born when his father's power was at its height, but along with that idolized father's abilities he inherited also his ill health. As a result he was such a delicate sickly boy that he was never sent to the great public schools, as were his

brothers, but was taught at home by private tutors until he entered Cambridge University, at 14. But he had such great abilities and was so well taught that at the age of seven he surprised people with his knowledge. Every night at home his father would make him read Greek and Latin authors aloud, and to this practice was attributed his extraordinary

readiness and fluency of speech.

William Pitt lived for politics. His chief amusement was to go to Westminster to hear his father speak. When his father was created Earl of Chatham, he is reported to have said, "I'm glad I'm not the oldest son, for I want to speak in the House of Commons as papa did." This wish was granted at the age of 21, as we have seen. At 23 he was chancellor of the exchequer, and at 24 he was prime minister of Great Britain—the youngest man who ever held that great office. For nearly a score of years in one of the most trying times in history he directed the affairs of his country—for 17 years in his first ministry (1783–1801), and two years in his second (1804–06).

During his first years in office Pitt reformed the finances of the kingdom and attempted to bring about other reforms. But before he could accomplish much the French Revolution broke out, and the time for internal reforms was past. Pitt kept England neutral as long as possible, but the excesses of the revolutionists so outraged the feelings of the English people that in 1793 peace became an impossibility.

For the rest of his life, except the three brief years (1801-04) when he was out of office because King George III would not support his measures to allay Irish discontent, Pitt had to struggle with problems arising from the great war with revolutionary France. He not only had to keep a strong fleet on the seas and an army on land, but he had also to provide

money for England's allies on the Continent. His measures may not always have been the wisest ones, but it is doubtful if anyone else could have solved the many knotty problems so well.

At length the struggle proved too much for Pitt's frail body. Napoleon's victory at Austerlitz over

England's allies, the Austrians and the Russians, proved his deathblow. Even the news of Nelson's great naval victory at Trafalgar, while it cheered him, could not postpone the end. He died on Jan. 23, 1806, less than two months after Austerlitz. A short time before his death he exclaimed, "Roll up the map of Europe. It will not be needed for another ten years." Equally memorable was this other saying: "Let us hope that England, having saved herself by her energy, may save Europe by her example." The saving of Europe from Napoleonic domination was in a large measure the work of William Pitt, one of the

greatest prime ministers that Great Britain has ever had.

PITTSBURGH, PA. By good rights are Pittsburgh's skies red by night and murky by day, for it commands the Slaves of the Lamp—fire, the fuels that feed it, and the industries nourished by it. Here, where the Allegheny and the Monongahela rivers cleave the hills to meet and form the mighty Ohio, is one of the most magnificent city sites in the world, comparable to those of Edinburgh and Florence. Surrounded by lovely woodland and splendid bluffs, the seething city bursts the bonds with which the Y-shaped channel of the two source rivers would bind it, and spreads across to the farther banks—a dense mass of factories, mills, docks, and warehouses, gridironed with railroads, overhung with smoke, and resonant with the unceasing clangor of engines and machinery.

First the rivers, then the fuels with which the region abounds—first transportation, then power—made Pittsburgh a great city. Young George Washington, who visited the locality in 1753, saw the strategic importance of the site as the gateway to the West. But the French built Fort Duquesne there the next year, and it was not until 1758 that this post was reduced by the English and christened Fort Pitt,

or Pittsburgh.

A great railway system has arisen to meet the city's needs—but unlike most American rivers, the three which meet here have not resigned their functions of transportation. Long processions of barges creep over the waters, bearing coal from northern West Virginia, a hundred miles away, to which the Monongahela gives access, and from upper western Pennsylvania, whose coal and oil fields are tapped by the Allegheny. The Ohio River opens the road to the Mississippi and the Gulf of Mexico—taking in



WILLIAM PITT, THE YOUNGER Prime Minister of England at 24

Cincinnati, St. Louis, and New Orleans on the way. The heavy freight of Pittsburgh by land and water is greater than that of any other city in the world.

Pittsburgh is a great manufacturing city because it is the focus of the largest and most productive coal field on the continent and of a highly productive oil field, and taps one of the richest gas fields in the world. A large proportion of all the coke manufacbaked goods, meat products, refined oil, brass and bronze products, paints and varnishes, and bathroom fixtures.

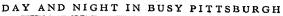
Pittsburgh has many institutions in which industrial research is carried on to find new products and new and more efficient methods of manufacture. In the laboratories of Mellon Institute all manner of problems for industry are investigated. In Pittsburgh

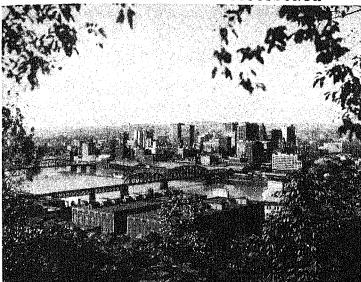
> also are an experiment station of the United States Bureau of Mines and the headquarters of the Mines Safety Conference of the Bureau.

The city is not nearly so smoky as it once was. The smoke from the coke ovens which once belched down on Pittsburgh is now converted into tar and benzol and gas. The city also has spent much money on smoke-control devices, and gas has to a certain extent replaced coal as fuel. The haze over the factory districts and over the workers' houses clinging to the hills is partly due to mist from the rivers.

Culture Grows with Industry

The "Golden Triangle" of Pittsburgh is the nose of land where the Allegheny and Monongahela rivers meet to form the Ohio. Here are the skyscrapers of the business district and the large department stores.



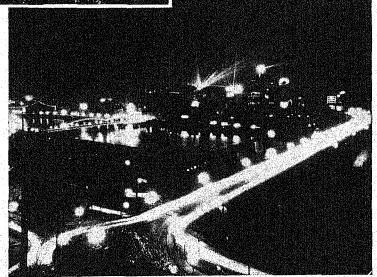


tured in the United States and about ten per cent of all the bituminous coal mined in the world comes from the

Pittsburgh district.

The "Smoky City" is also the "Iron City" and the "City of Steel," tor it makes more pig iron and steel than any other city of the United States, and more steel rails, steel plates for shipbuilding, and pressedsteel cars and coaches than any other city in the world. The structural steel industry originated here. Pittsburgh barbed wire helped to win the World War. The aluminum industry had its rise out of experimental work by Pittsburgh men. Pittsburgh leads the world in the manufacture of plate glass, window glass, pressed tableware, bottles, and lamp chimneys, and produces a high grade of optical glass. The largest cork factory in the world makes every cork product from bottle

stoppers to life preservers and floor coverings. The city leads also in the manufacture of air-brakes, electrical machinery, railway signals and other safety devices, fire brick, white lead, and tin plate. Other products are chemicals, especially those derived from coal-tar, canned and preserved foods, bolts and nuts,



Where old Fort Duquesne once stood on the Golden Triangle at the junction of the Allegheny and Monongahela rivers, skyscrapers rise in Pittsburgh today, and flash their beacons by night over the City of Steel.

Some blocks east is the civic center, the Schenley Park district, with its sumptuous homes and public buildings. School children gave their pennies and manufacturers their thousands of dollars in 1924-25 to build here the "Cathedral of Learning," a Gothic skyscraper to house the University of Pittsburgh, which dates from 1787. On the university campus is the Stephen Collins Foster Memorial Building, used as a music hall and little theater. Close by is Mellon Institute of Industrial Research, which occupies an entire block. Against the background of Schenley Park stand the buildings of Carnegie Institute of Technology and the Carnegie Institute and Library. The latter building houses, in addition to its great library, a music hall, a museum of natural history, art galleries, and halls of sculpture and architecture. Phipps Conservatory, in Schenley Park, has some 125,-000 species of flowers and plants. School children study botany in its Hall of Botany. Farther east, around Highland Park on the Allegheny River and Frick Park to the south, near the Monongahela River, are attractive residential areas.

From the narrow limits of the Triangle, the city has spread over the hills to the north and south beyond the rivers. The Triangle is connected with the South Hills residential district, south of the Monongahela, by the Liberty Bridge and twin Liberty tunnels under Mount Washington. To the north, across the Allegheny River, is the old town of Allegheny, long since absorbed by Pittsburgh. In Riverview Park is the noted Allegheny Observatory. Beyond the city limits, in the beautiful forested foothills of the Allegheny Mountains, are North and South County parks. Each covers more than 2,000 acres.

Some of the City's Noted Names

Andrew Carnegie and his associates Henry Phipps and William R. Jones made vast fortunes in steel at Pittsburgh (see Carnegie, Andrew). Henry Clay Frick built up a great coke business before becoming a Carnegie partner. Here H. J. Heinz built his food factories, and George Westinghouse, inventor of the air brake, became a power in the electrical world. Andrew W. Mellon, secretary of the treasury under three presidents and ambassador to Great Britain, with his brother Richard B. Mellon developed great aluminum and coke industries.

Stephen C. Foster, America's favorite song writer, was a Pittsburgh boy, and Charles Wakefield Cadman and Ethelbert Nevin received their first recognition here. The artists John White Alexander and Mary Cassatt and the singer Louise Homer were born in Pittsburgh. Among poets, playwrights, and novelists, the city claims Gertrude Stein, Robinson Jeffers, Marc Connelly, George S. Kaufman, Mary Roberts Rinehart, and Margaret Deland.

A Battleground in Colonial Days

French and English fought over the Golden Triangle in their struggle for possession of North America. In 1753 the French started to build forts in western Pennsylvania. The governor of Virginia sent George Washington, then a young militia officer, to warn away these trespassers on Virginia's western lands. He wrote in his journal: "I spent some time in viewing the rivers and land in the forks, which I think extremely well situated for a fort, as it has absolute command of both rivers." A company of Virginians

started a fort, but the French drove them away, and built Fort Duquesne. Washington returned with a few hundred troops, but a superior French force compelled the surrender of his hastily built Fort Necessity. These clashes began the French and Indian War. (See French and Indian War; Washington, George.)

General Edward Braddock met defeat and death in his attempt on Fort Duquesne in 1755. It was finally captured in 1758 after it had been burned by the French. The following year the English built Fort Pitt, named in honor of William Pitt the Elder, British prime minister and friend of the American colonies. During the Pontiac War, in 1763, Fort Pitt was besieged by the Indians from June 27 to August 6. The next year a brick blockhouse was built within the outer walls of the fort. It is still standing, surrounded by the skyscrapers of the Golden Triangle.

An Early Trade Center

By the end of the 18th century the settlement around the fort, called Pittsburgh, had become a busy river port. It was the starting place for immigrants moving to the West, and their demands for manufactured products stimulated industry and commerce. Such pioneer necessities as axes, knives, nails, shovels, calico, shoes, saddlery, and window glass were being made. Goods from the ocean port of Philadelphia were moved overland across the mountains by Conestoga freight wagons and then floated down the Ohio on flatboats and keel boats. The first steamboat on western waters left Pittsburgh for New Orleans in 1811. The city was incorporated in 1816.

During the Civil War Pittsburgh iron foundries supplied the Union armies with munitions and armor plate. A tremendous industrial expansion followed the close of the war, and by 1875 the city was supplying a world market with steel and steel products. A large foreign population poured in to work in the mills. Here were born such great labor organizations as the United Mine Workers of America and the American

Federation of Labor. Population, 671,659.

PIUS, POPES. Twelve popes have borne the name Pius. The earliest (PIUS I, 140–154?) belonged to the period before Christianity was a tolerated religion. The latest was elected to the papal throne in 1939.

Pius II, who was pope from 1458 to 1464, was a famous "humanist" scholar and writer of the Renaissance, named Aeneas Sylvius Piccolomini. He was born at Siena and won his cardinalate by his services in bringing Germany back to the Roman obedience, after the schismatic Council of Basel (1431-1449) and its anti-pope Felix V. As pope he continued the patronage of learning and art begun by Nicholas V, 1447-1455; but his chief interest was in arousing Europe to a crusade against the Turks who had taken Constantinople in 1453. He died at Ancona, Italy, waiting for the fleet and armies which he vainly hoped would rally at his call. His letters and other literary works are important sources for the history of the time. Plus III, who was pope for less than a year (in 1503), was a nephew of Pius II.

MID ABOUTOUR

Prus IV, 1559–1565, and Pius V, 1566–1572, were both active in furthering the work of the Council of Trent and in checking the spread of Protestantism. Prus VI, 1775–1799, and Prus VII, 1800–1823, belonged to the period of the upheaval caused by the French Revolution and Napoleon Bonaparte. Prus VIII, 1829–1830, lived too short a time after his election to accomplish anything.

The Doctrine of Infallibility

PIUS IX, 1846-1878, was perhaps the most memorable pope of this name, alike because of his long pontificate, his early liberalism in politics (until checked by Mazzini's attempt to establish a republic in Rome, in 1849), the stern reaction in the papal government which followed under Cardinal Antonelli. and the loss of the temporal power of the papacy in 1870, when Rome was by force made the capital of the new kingdom of Italy. Pius IX thereupon established the policy by which the pope confined himself to the Vatican Palace and its surroundings, and refused recognition to the Italian king. In 1854 Pius IX issued a bull establishing as a doctrine of the church the dogma of the Immaculate Conception of the Virgin Mary. The Vatican Council, held by him in 1869-70, further proclaimed as a necessary part of the Catholic faith the doctrine of the pope's infallibility when acting officially on matters of faith and morals.

Pros X, 1903-1914, was born of humble parents, his father being a postman near Venice. After becoming a priest, at the age of 23, he rose to be bishop of Mantua, was made a cardinal in 1893, and shortly afterward became Patriarch (archbishop) of Venice. His schools and his work for missions and religious societies made him known throughout Italy. His rule as pontiff was marked by his abolition of the veto of Austria, France, and Spain on the election of the pope; and by his stanch advocacy of the Gregorian chant and opposition to secular music in the services of the church. In his pontificate came the laws in France decreeing the complete separation of church and state. When the World War came, Pius X issued (Aug. 19, 1914) an ineffectual appeal for peace, and his death, at the age of 79, is said to have been hastened by grief over the war.

Pius XI, 1922–1939, won the most notable triumph in the modern history of the church, for he regained the temporal power of the papacy. This power, which symbolized the independence of the church, had been lost since 1870, when Italy had seized the Papal States (see Papacy). Early in his pontificate, Pius XI opened the way for settling the dispute, called the "Roman Question," between Italy and the Vatican. In accord with his belief that the church had no place in party politics, he dissolved the Catholic party in Italyas he was to do later in Mexico and France. He thus won the good will of Premier Mussolini, who then in 1925 began negotiations with the Vatican. On Feb. 11, 1929, the Lateran Treaty was signed. This treaty made the pope a sovereign ruler and Vatican City an independent state. The papal realm, comprising some 109 acres, became the smallest free nation in the world. As compensation for the territory seized in 1870, Italy paid 1,750,000 lira.

In the following years, Pius XI won world-wide fame as an advocate of peace. He insisted that world peace depended on the ideals of Christianity. He therefore stood firmly against any form of government that repressed religion. This policy gave him an active part in world affairs, for after the first World War religion became a political issue in many nations, especially Mexico, Russia, Germany, and Spain. By radio broadcasts and encyclicals, the pope rebuked the states that showed religious intolerance. He denounced also the persecution of Jews and other minority peoples, calling upon all rulers to respect the "natural rights of man." For his tireless pleas for

tolerance and international good will, he became known as the "Pope of Peace."

With equal vigor he faced the social problems that arose from the unrest following the World War. He declared that widespread unemployment showed a need for economic reform, with industry recognizing the rights of workers. He also urged workers to rid themselves of envy and to coöperate with industry. Other encyclicals cham-



PIUS XI Called "Pope of Peace"

pioned the need for Christian education and for self-discipline in young people. His encyclical on motion pictures led Catholics in the United States to form a "Legion of Decency" to boycott films considered immoral.

During the reign of Pius XI, the Catholic church grew remarkably despite the oppression of religion in many quarters. Reorganizing the missions, which had been disrupted by the World War, he broadened the scope of missionary work. Membership in the Roman Catholic church is estimated to have soared from about 280,000,000 to some 330,000,000.

Until his rise to the papacy, the life of Pius XI was unusually tranquil. His name was Ambrogio Damiano Achille Ratti, and he was born at Desio, near Milan, May 31, 1857. He was schooled largely by his father, director of a silk factory. When only ten years of age, the boy began his studies for the priesthood. He was ordained in 1879. After a few years of seminary teaching, he was appointed prefect of the Ambrosian Library in Milan. In 1914 he was called to Rome to take charge of the Vatican Library. His hobby was mountain climbing and he became a famous Alpinist. In 1918 he was sent to war-torn Poland to protect the church against the inroads of bolshevism. For his executive ability, he was made cardinal in 1921. Less than eight months later, he was elected pope to succeed Benedict XV.

PIUS XII (Eugenio Pacelli) was elected pope on Mar. 2, 1939, his 63rd birthday, to succeed Pius XI. The new pope, who had been papal secretary of state, chose the name Pius out of respect and affection for his predecessor. His coronation took place March 12.

The election of Pius XII was unusual in many ways. He was the first papal secretary to succeed to the papacy in modern times. His election was the swiftest in history, for he was chosen by the electoral conclave on the first day of voting after only three ballots. He was the first native of Rome to be elevated to the

papacy in more than 200 years, and the first pope who had visited the United States.

Born in Rome Mar. 2, 1876, Eugenio Pacelli (pächěl'lĭ) was a member of a patrician family which held the titles of Nobles of Acquapendente and of Sant' Angelo in Vado. For two centuries the family had been associated with the affairs of the church, and Eugenio Pacelli's father was a lawyer for the Vatican. Like his father, the boy was expected to study law; but when he finished his education in the parochial schools of Rome, the tall, serious young scholar decided to become a priest. He was graduated from the Gregorian University at Rome in 1898. Three years later he was ordained, and shortly thereafter was assigned by Pope Leo XIII to the Secretariat of State.

This was the turning point of his career, for in this department of the Vatican, under four successive popes, he gained an insight into European affairs which was to make him one of the leading statesmen of his time. Father Pacelli was admirably fitted for such work. He was a remarkable linguist, speaking French, German, English, Spanish, Portuguese, and Hungarian, in addition to Latin and Italian. His quiet friend-liness and modesty drew people to him, and made him a splendid conciliator. For several years he worked tirelessly as a humble clerk. His care of detail and his rare tact won the attention of Pope Pius X, who advanced him to undersecretary in 1912.

In 1917 he was consecrated titular archbishop of Sardi and was immediately sent to Germany as papal nuncio by Pope Benedict XV, who was then trying to halt the World War. Archbishop Pacelli carried the papal plea for peace to Kaiser William II. Though the plea was refused, the archbishop was received graciously and stayed on in Munich, where he helped to organize the exchange of war prisoners. After the war ended, he remained at his post through the troubled

years of the German Republic. In addition to his diplomatic duties, he found time to do relief work among the people who had been impoverished by the war. He became dean of the diplomatic corps, and was often called on to act as its spokesman. A splendid orator, he gave the annual address of the corps to President von Hindenburg. Each year the keynote of his address was a plea for world peace.

In 1929 Pope Pius XI conferred the cardinal's hat upon him, and a year later appointed him papal secretary of state. In this office, Cardinal Pacelli negoti-

ated several important concordats, notably one with Adolf Hitler's new government in 1933. As social and political unrest spread, he became noted for his stand against communism and against the efforts of dictator governments to repress the church. In 1935 he declared that the church would always oppose "enemies who were possessed by superstition of race or blood." His first papal address was a plea for world peace. Shortly after the outbreak of the war, he sent out his first encyclical, Oct. 27, 1939, condemning theories of racial supremacy and principles of totalitarian government. His second encyclical, Nov. 11, deplored the growth of materialism, pleaded for a "living wage" for workers and defended their right to organize.



Three years before he became pope, Cardinal Pacelli visited the United States. We see him here at the left receiving an honorary degree from the Rev. John F. O'Hara, president of Notre Dame University.

Pius XII repeatedly declared that, as the spiritual leader of Catholics everywhere, he favored no country above another, but that he must decry the brutal aggressions of the Nazis and must throw his moral force on the side of the peoples they oppressed. In his unceasing efforts toward peace he frequently consulted with President Franklin D. Roosevelt's personal representative at the Vatican.

PIZARRO (pi-zăr'ō), Francisco (about 1471-1541). The story of the conquest of Peru by an obscure adventurer forms one of the most dramatic episodes in the history of the New World. At the age of 50 Pizarro was a captain of infantry on the Isthmus of Panama, with nothing to show for years of toil and peril but a small holding of land. In little more than a decade he had conquered the fabulously wealthy empire of the Incas, and had bestowed on Spain the richest of her possessions in the Americas. Violence and perfidy were the instruments with which he worked, and by violence and perfidy he came to his death. Resolute and daring to the last degree, he was infinitely greedy and merciless, and the sufferings

POPE PIUS XII



of the peaceful natives of Peru at his hands are one of the saddest chapters in history.

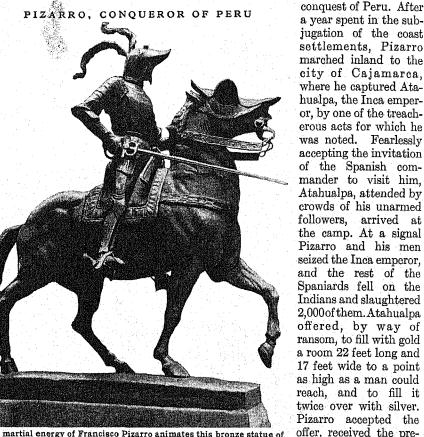
In extenuation of Pizarro's crimes it must be remembered that his early days were cast in dark places. He was the illegitimate son of a Spanish colonel, and was left to grow up without care. To the end of his days he was never able to write his

name, and tradition says that his youth was spent as a swineherd. Some time before 1510 he sailed to seek his fortune in the recently discovered New World. After accompanying Balboa in the journey that resulted in the discovery of the Pacific Ocean (1513), he became a cattle farmer. Then reports reached him of a vast and wealthy empire to the south. Pizarro's imagination was kindled and he sought the aid of two friends in equipping an expedition for its conquest. His associates were another soldier named Diego de Almagro, who was to equip the expedition, and the vicar of Panama, Hernando de Luque, who was to furnish the funds. The three men entered into a famous written agreement, dividing equally the spoils of the empire they hoped to master. A first expedi-

tion resulted in disaster, after two years of suffering and hardship. A second expedition in 1526 fared little better. The adventurers found they were too few for the task, and Almagro was sent back to Panama for reinforcements, while Pizarro and part of the force remained on an island. But the governor of Panama was not inclined to support the enterprise, and sent vessels to bring back Pizarro and his men. Pizarro refused to return, and, drawing a line on the sand. called upon all the men who wished to remain and share in his enterprise to come over to his side. Thirteen men crossed the line, but the others returned. Soon after this the governor was induced to send one vessel to Pizarro, with which he explored the coast of Peru and collected information concerning the empire of the Incas

Discouraged at the indifference of the governor. Pizarro returned and sailed to Spain, where he applied for authority to undertake the conquest of Peru. A commission was given him for his enterprise, and he sailed from Spain on Jan. 19, 1530, and from Panama the following year, with 3 vessels, containing fewer than 200 men and about 40 horses.

After seven years of hardship and disappointment the adventurers were now embarked on the actual



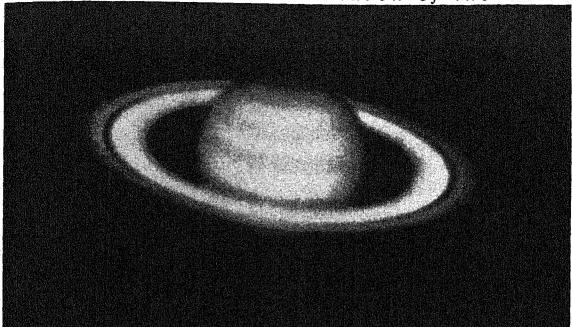
The martial energy of Francisco Pizarro animates this bronze statue of the conqueror of Peru by Charles Cary Rumsey, American sculptor. Notice the 16th-century armor for both horse and rider.

jugation of the coast settlements, Pizarro marched inland to the city of Cajamarca, where he captured Atahualpa, the Inca emperor, by one of the treacherous acts for which he was noted. Fearlessly accepting the invitation of the Spanish commander to visit him, Atahualpa, attended by crowds of his unarmed followers, arrived at the camp. At a signal Pizarro and his men seized the Inca emperor, and the rest of the Spaniards fell on the Indians and slaughtered 2,000 of them. Atahualpa offered, by way of ransom, to fill with gold a room 22 feet long and 17 feet wide to a point as high as a man could reach, and to fill it twice over with silver. Pizarro accepted the offer, received the precious metal, estimated as worth more than \$15,-

000,000, but soon after had Atahualpa tried and executed on charges of murder and treason.

Pizarro then marched to Cuzco, and set up the young Inca, Manco, as nominal sovereign. In 1535 he founded the Ciudad de los Reyes (city of the kings) now Lima, the present capital of Peru, as the capital of his new government. Manco escaped and headed an unsuccessful uprising. Two or three years later a fierce quarrel arose between Pizarro and Almagro concerning the territory each was to govern. This contest assumed the proportions of a civil war and resulted in the capture and execution of Almagro. But the embittered and discontented followers of Almagro conspired against Pizarro and finally assassinated him on June 26, 1541. In a glass case in the cathedral of Lima are a pile of moldering bones, said to be those of the pitiless conqueror of Peru. (See also Incas; Peru; South America.)

The NINE PLANETS - Children of the SUN



Saturn with its rings and its cloud-streaked atmosphere is the most spectacular of the planets. This photograph shows how it looks through a 6-inch telescope. The dark dividing line between the two outer rings is called Cassini's division.

PLANETS. Most people can recognize some of the bright planets. They know that Venus is the brilliant starlike object which appears sometimes in the western sky at dusk and at other times in the east at dawn. They can point out Jupiter, which is also brighter than any star, and can recognize Mars by its red color. Fewer people can identify Saturn, and still fewer have ever noticed the elusive Mercury, appearing near the horizon as an evening or morning star. These are the bright planets. Uranus is barely visible to the unaided eye, while Neptune and Pluto can be seen only with the telescope.

One way to tell a large planet from a star is by its steady light. Stars twinkle because the atmosphere constantly causes slight deviations of their pin-point light rays. The planets, being so much nearer, send to us beams of light so broad that the atmospheric effect is scarcely noticeable. Planets can also be identified by their motion. If you are in doubt about a bright, starlike object, watch it from week to week. If it changes place relative to near-by stars, it is a planet. The ancient Greeks invented the name, which in their language means "wanderer."

Motions of the Planets

The planets, like the earth, belong to the solar system and revolve around the sun. As we shall see, some are closer to the sun than the earth is, others are much farther away, and no two of them make the trip around the sun in the same length of time. With these facts in mind, we can understand their motions in the heavens, which otherwise might appear to be extremely erratic.

Because the earth rotates on its axis, the planets, like all other heavenly bodies, seem to sweep across the sky each day from east to west (see Earth). But the motions that are likely to be confusing are those which the planets make relative to one another and to the background of the stars.

Compared to the stars, the planets are very close to us. If we draw a picture of the solar system, showing the most remote planet at three feet from the sun, then, to be accurate, we will have to place the nearest star about four miles away. Astronomers know from extremely delicate calculations that the stars have independent motions, some rushing closer together, others drawing apart. But their distances from us are so great that we cannot observe these motions directly, and the stars seem today to form the same unchanging pattern in the sky as they did in the days of the ancient Egyptian and Chaldean astronomers. The planets, on the other hand, are close enough to us to show their motions plainly.

They travel around the sun in the same direction as does the earth. If we imagine ourselves looking down on the solar system from above the North Pole, this direction is counterclockwise. To an observer on the sun, therefore, they would all be moving along their orbits from west to east. But because of the earth's position and its own motion around the sun, the planets appear to move part of the time from west to east across the stars (direct motion) and part of the time from east to west (retrograde motion).

The occasional retrograde or backward motion can be explained with Mars as an example. This planet does not move as rapidly as the earth along its orbit, and at times the earth overtakes and passes it. When this happens, Mars seems to turn back for a time, just as a train falls behind when we pass it on a faster train.

Planets as a Group

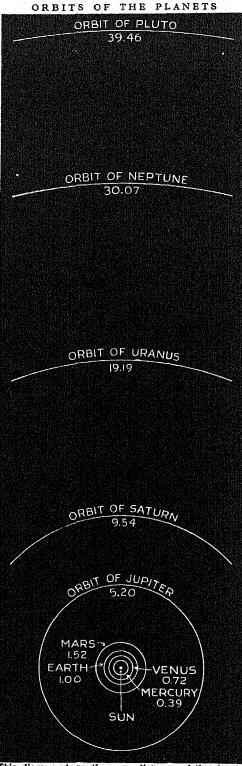
All the planets, the earth included, differ from the sun and the stars in one important way. The sun and the stars are huge globes of glowing hot gas, and hence they give off light. The planets are all cool and solid, like the earth, and do not give off light of their own. They shine because they reflect light from the sun.

The planets are small compared to the sun and the stars; but they appear large enough to show as disks, even in small telescopes, because they are relatively near to us. These comparatively large-appearing surfaces reflect light enough to make the planets brighter than any of the stars.

The principal planets present much variety, as the accompanying table shows. In it are listed the nine principal planets, including the earth, as distinguished from many hundreds of minor planets, called planetoids or asteroids, which steer their courses mostly between the orbits of Mars and Jupiter (see Asteroids). The principal planets are classified in two ways: (1) The inferior planets, Mercury and Venus, revolve within the earth's orbit, while the superior planets revolve outside the earth's orbit. (2) If the division is made at the zone of the asteroids, the inner planets are Mercury, Venus, Earth, and Mars; the outer planets are Jupiter, Saturn, Uranus, Neptune, and Pluto.

Tiny Mercury

Mercury is the smallest principal planet, the nearest



This diagram shows the mean distances of the planets from the sun in astronomical units. The earth's mean distance from the sun is equal to one astronomical unit. Equivalent distances in millions of miles are given in the table on the opposite page.

of all to the sun, and the speediest in its motion along its orbit. It revolves around the sun once every 88 days, and it overtakes the earth once every 116 days on the average.

Because of its small orbit, Mercury never seems to appear more than 28 degrees away from the sun. Hence we only see it after sunset, when it is at its greatest eastern elongation (meaning highest above the setting sun for observers in the United States). or before sunrise at its greatest western elongation (meaning highest above the rising sun). At these times it is the evening or morning star, and it often twinkles because of its small size and low altitude. At other times, it is in the sky together with the sun. and it is lost in the glare of the sunlight.

Usually as it moves between its positions above or below the sun, it passes to one side; but about 13 times a century it *transits*, or crosses the sun's disk. The nearest date for such a transit is Nov. 14, 1953.

Like the moon, Mercury has no atmosphere. Also it rotates once upon its axis during one revolution around the sun, and so it always presents the same face to the sun. This keeps the sunward side hot enough to melt tin or lead, while the other side is almost as cold as outer space.

Venus, "Twin Sister" of the Earth

Since the orbit of Venus is inside that of the earth, the planet seems to move from side to side of the sun, like Mercury, and at times passes between us and the sun. Hence it shows "full," "half," and "new" phases, like the moon (see Moon). The "full" and "new" phases occur at conjunction—that is, when Venus is in line with the

of the principal planets

that revolve outside the

earth's orbit. Mars goes

around the sun once in 687

days and the faster-mov-

ing earth overtakes it

every 780 days. The plan-

et is then at opposition-

that is to say, opposite the

sun's place in the sky and

occur when Mars is also

Favorable oppositions

These

nearer us than usual.

nearest the sun.

sun and the earth. The full phase occurs when Venus is on the other side of the sun from us, and rises almost with the sun, as a morning star. The "new" phase, which looks like a crescent, occurs when Venus is between us and the sun, and appears as the evening star. Venus is brightest, however, about 36 days before and after the crescent phase. Then the surface is less than it is at full; but its nearness causes it to reflect the most light. Like Mercury, Venus usually passes the sun on one side or the other at conjunctions, with an occasional transit. The next one will occur in 2004.

The telescopic view of

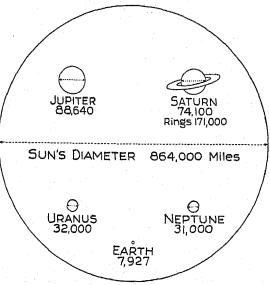
Venus is best in the daytime when the planet is high in the sky. Even then astronomers have rarely glimpsed any markings, and these are only clouds. Photographs with blue filters bring these out more clearly. Photographs with red filters, which are more effective in penetrating a murky medium, show nothing of the surface.

Since Venus resembles the earth in some respects and is not very much nearer the sun, people often ask whether it might not have some form of life. The astronomer answers cautiously, because he is unable

to observe the planet's surface. But as far down through the atmosphere as he can see, the evidence is unfavorable. Spectroscopic studies show no trace of the free oxygen that is essential to human life as we know it.

Mars

Mars is the red planet. It is considerably smaller than the earth, having a diameter of 4,200 miles, or only twice the moon's diameter. It is nearest to us HOW THE PLANETS COMPARE IN SIZE



Here the larger planets are drawn to scale against a disk representing the sun. On this same scale the smaller planets—Mercury, Venus, Mars, and Pluto—would appear as mere dots.

come at intervals of 15. or sometimes 17 years, when the planet's distance from the earth may be as little as 35 million miles. Favorable oppositions always occur in the late summer or early fall. Then Mars becomes the brightest starlike object in the sky except Venus.

The surface features of Mars are not completely hidden by the surrounding atmosphere. At times they show well in a large telescope. Greenish blotches are observed on the orange surface of the planet and are known by watery names, like the "seas" on the moon; but they are not bodies of water. Finer markings have been called "canals." White caps are seen at the poles. Each cap grows larger during the winter in that hemisphere and diminishes as summer approaches, like the caps of snow and ice around the poles of the earth. The seasons of Mars resemble ours, except

that they are

longer.

The atmosphere of Mars is rarer than the earth's atmosphere. Water is scarce. The temperature is low. but it rises above freezing at noon in the tropics. Human life could perhaps exist under such conditions. Yet the failure to detect a trace of oxygen in the Martian atmosphere with a spectroscope argues against the possibility. The possibility of plant

life is somewhat

THE PRINCIPAL PLANETS

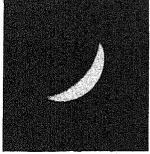
Name		Mean Dis- tance from Sun			Equato- rial Diam- eter	Period of Rotation
		Million Miles	*Sidereal	*Synodic	Miles	
MERCURY	- ਉ	36.0	88.0 days	115.9 days	3,100	88 days
VENUS	Q	67.2	224.7 days	583.9 days	7,700	30 days?
EARTH	⊕	92.9	365.3 days		7,927	23h56m
MARS	o ⁷¹	141.5	687.0 days	779.9 days	4,215	24 37
JUPITER	2	483.2	11.9 years	398.9 days	88,640	9 50
SATURN	Ь	885.9	29.5 years	378.1 days	74,100	10 14
URANUS	ð	1782	84.0 years	369.7 days	32,000	10 45
NEPTUNE	Ψ	2793	164.8 years	367.5 days	31,000	15 48
PLUTO	P	3670	247.7 years	366.7 days	4,000?	?

*The sidereal period is the true period of revolution as seen from the sun. The synodic period is the interval between the times when the planet overtakes the earth or the earth overtakes the planet in their revolutions around the sun.

The symbols for the first six planets have been used by astronomers and astrologers since ancient times. Designs such as a mirror for Venus suggest the divinity for which the planet was named. As the other planets were discovered, symbols in keeping with the ancient ones were adopted. greater. The greenish markings become unmistakably greener with the coming of spring in that Martian hemisphere and fade during the autumn season, as

they might do if they are areas of vegetation.

Two tiny satellites revolve around Mars; they are not more than ten miles in diameter. Phobos, the inner one, is only 5,800 miles from the center of the planet, or 3,700 miles from its surface. It revolves from west to east once in 7 hours 39 minutes. while Mars itself rotates on its axis in the



Through a telescope Venus looks like a crescent moon, when it is between the earth and the sun.

same direction once in 24 hours 37 minutes. Phobos is the only satellite in the solar system that goes around its planet in a shorter period than that of the planet's rotation. As seen from Mars this satellite rises in the west and sets in the east. Deimos, the outer satellite, is 14,600 miles from the center of Mars and circles around it once in about 30 hours. This satellite, therefore, rises in the east in the Martian sky as our own moon does.

The "Giant" Planet Jupiter

Jupiter is the giant planet. Its equatorial diameter, 88,600 miles, is eleven times as great as the earth's diameter and its mass is greater than the com-

bined masses of all the other planets. It is the brightest starlike object in the heavens, except Venus and occasionally Mars. Five times as far from the sun as the earth's distance, this planet revolves around the sun once in nearly 12 years. It is overtaken by the earth every 399 days and on each occasion is found about one constellation of the zodiac east of its former place.

Only a small telescope is needed to see a succession of dark streaks across the planet's disk. These are the "cloud bands" which separate the bright zones of the greatest cloudiness. What is seen is the outside of the extensive atmosphere; it is impossible to look through to the surface. Large telescopes show dark and bright spots as well, which at times change in form

quite rapidly. Yet an elliptical spot about 30,000 miles long, the "great red spot," has persisted for a century or more.

All these markings are carried around at different rates by the planet's rotation. Jupiter rotates on its axis in a little less than ten hours, the shortest rotation period of any of the principal planets. The decided flattening of the disk at the poles is a result of this swift rotation.

Sunlight is feeble at Jupiter's great distance from the sun, and the temperature of the atmosphere is 200° F. below zero. These clouds are surely not composed of water, because if water exists on the planet it must remain permanently frozen. Astronomers once wondered what could be evaporating at the surface and rising to condense into clouds. Rapid changes in the cloud formations suggest that this action must be vigorous. The spectroscope has solved the puzzle. Important constituents of the planet's atmosphere are ammonia and methane. These substances can evaporate in the extremely cold climate of Jupiter.

The telescope shows that Jupiter has four bright satellites. These satellites, discovered by Galileo in 1610, could be glimpsed without the telescope, if they were not obscured by the glare from the planet. Since their orbits are presented nearly edgewise to us, the satellites appear to move forward behind the planet and through its shadow, and then backward across its disk, casting shadows as they pass. The first and second satellites are about the size of the moon. The third and fourth are half again as great in diameter as the moon; these two are the largest satellites in the solar system and they surpass the planet Mercury. Jupiter has seven other satellites, but they are small and faint, even in telescopes.

Saturn and Its Rings

Saturn is the most remote of the bright planets, being about ten times the earth's distance from the sun, and it was long thought to be the outermost planet of all. It revolves around the sun once in $29\frac{1}{2}$

years at the average distance of 886 million miles. With its equatorial diameter of 74,100 miles it is second in size to Jupiter. Saturn has nine known satellites. Titan, the largest, is 2,600 miles in diameter, or somewhat larger than the moon. Phoebe, the smallest and most distant from Saturn, revolves around the planet from east to west; the others revolve from west to east. The innermost five revolve in from about one to four days.



This drawing of Mars shows a polar ice cap at the top, also the lines which some observers have considered canals. These observers suggest therefore that the planet must have intelligent inhabitants.

Like Jupiter, Saturn is surrounded by impenetrable atmosphere, with cloud bands running parallel to the Equator. All ammonia has been frozen out of the atmosphere, but methane is abundant. A few bright spots have been seen, going around in different periods. Those near the Equator suggest that Saturn rotates once in 10 hours 14 minutes.

Saturn is remarkable because of three encircling rings. These three concentric rings lie in the plane of the planet's equator and extend outward 170,000 miles. The middle ring is the brightest; it is separated from the outer ring by a dark space called Cassini's division. The inner, or crêpe ring, is very dim.

The rings are composed of many separate pieces, like tiny satellites. The pieces reflect sunlight, which runs together to give the appearance of continuous surfaces. The Cassini division is a narrow zone where practically no pieces exist, while in the crêpe ring the pieces are evidently widely spaced.



An ultraviolet filter helped obtain this fine photograph of Jupiter, showing the huge bands of clouds which usually streak the atmosphere of this giant planet.

The rings are inclined 27 degrees to the plane of the planet's orbit. First the northern face of the rings, and then the southern, is presented to the earth. During short periods about 15 years apart, the rings are edgewise to the sun, and at times within each period, to the earth. At such times, the rings cannot be seen except with the largest telescopes.

Uranus, Neptune, and Pluto

Nobody supposed that a more remote planet existed beyond Saturn, until William Herschel of England

discovered Uranus accidentally in 1781. Soon this planet puzzled astronomers because it did not follow the expected course. In 1846 Leverrier of France found the answer to the puzzle. His calculations suggested that Uranus was drawn from the predicted path by a planet still more remote, and he predicted the place of the disturber in the heavens. Galle in Germany pointed his telescope in that direction and identified the new planet. That was the planet which was named Neptune.

Uranus can be glimpsed with the unaided

eye. Nineteen times as far from the sun as the earth's distance, it revolves around the sun once in 84 years. It is attended by four satellites, which have orbits nearly at right angles to the plane of the planet's orbit.

Neptune is always invisible to the unaided eye. Its distance from the sun is thirty times as great as ours, and its period of revolution around the sun is 165 years. Neptune's only known satellite is considerably larger than the moon; it revolves around the planet from east to west. Uranus and Neptune are each about 30,000 miles in diameter. Their tiny greenish disks show no markings through the telescope, but they are enveloped in clouds.

Pluto is the most remote of the known principal planets. It was discovered in 1930 at the Lowell Observatory by astronomers who had suspected its existence because some very slight irregularities remained in the motion of Uranus after taking account of the attraction from Neptune. Pluto was found about as predicted, but it proved to be too small to account for all the disturbances in the orbit of Uranus.

Pluto is visible only through large telescopes. It is probably about the size of Mars, and its yellow color

suggests that it has very little atmosphere. Pluto revolves around the sun once in 248 years at an average distance 40 times our distance from the sun. Its orbit is so eccentric, however, that part of it lies inside the orbit of Neptune.

How Did the Planets Come into Being?

The first modern attempt to explain the existence of the sun and its solar system of planets was the nebular hypothesis advanced by the French astronomer Laplace in 1796. He supposed that the system condensed from a huge nebula, or mass of hot gas (see Nebula). As it shrank it supposedly

left rings behind, like those around Saturn. These condensed into planets, and the central mass condensed into the sun.

Today astronomers reject this view, because mathematical analysis proves that a nebula would not condense as supposed. About 1900, Professors Chamberlin and Moulton of the University of Chicago began developing their planetesimal theory. This held that a central mass, now the sun, ejected clouds of matter in small bits called planetesimals. The larger gathered in the smaller by superior force of gravity and became planets.

Various objections to this view led Sir James Jeans to propose the *tidal* theory. This suggests that a fast-moving star passed our sun

and drew out streamers of matter, which condensed into planets. Another British astronomer, Harold Jeffreys, suggested an actual collision between the sun and the passing star; but none of these theories is completely satisfactory.

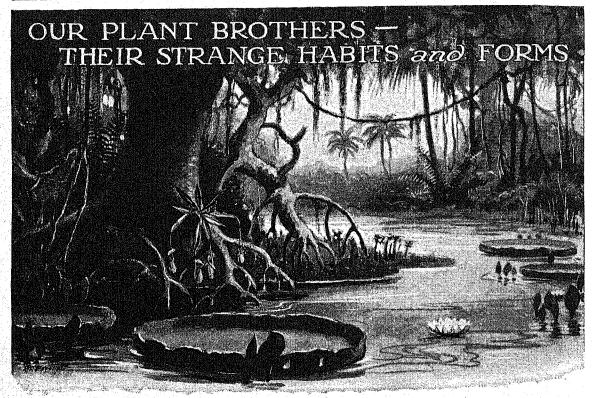
Facts about Orbits and Motions

The orbit of every planet is an ellipse, with the sun in one focus. The amount of deviation from a circle is (roughly) the eccentricity. For most planets it is slight; for the earth, it is less than 2 per cent (see Earth). For Mercury, however, it is one-fifth, and for Pluto one-fourth. All the orbits except those of Mercury and Pluto lie almost in the plane of the ecliptic.

In their revolutions about the sun, planets obey the rough rule, "the nearer the sun, the faster the motion." The exact rules are known as Kepler's Laws, from their discoverer (see Kepler, Johann).

A large telescope has obtained this view of Nep-

tune and its one satellite.



PLANT LIFE. The first thing to keep in mind about plants is that they are alive. They eat and drink, they breathe and move, they rest and sleep, they are born and die, very much like men and animals. Most of them "see" after their own fashion, and many have exceedingly sensitive reactions to touch and other stimuli. They grow strong and healthy with plenty of good food, but get sick and pine away if the food is bad or scarce.

Though at first the life of plants may seem exceedingly dull, sluggish, and uninteresting, we soon find out, if we learn

the plant language, that they have many exciting adventures, hairbreadth escapes, tragedies, and triumphs in the round of their existence. Every tree, every flower, every bit of moss or fungus you see growing so quietly in Nature's wilds is a hero—surviving champion of a struggle against countless obstacles, powerful enemies, and continual dangers.

THE story that plants tell is one of the most wonderful tales in the world. You may learn it from the tiny radish and from the mighty sequoia, from the brown seaweed in its salty home and the brilliant orchid in the tropical jungle. Parts of the story come from the lichens and mosses of frozen Siberia, and parts are whispered to men as they cut their way through the tangled masses of the Congo forests. Some of the secrets are hidden in the soft body of the fairy mushroom, and some in the iron-hard fruit of the ivory palm. Whole chapters can be read only through the microscope—the adventures of the yeast plant, for instance, that raises our bread, and the terrible work of the bacteria of disease. This neverending story, with all its fascinating details, awaits those who know the simple language of the plants—a language that has leaves and flowers, roots and stems, colors and smells, strange shapes and habits for its alphabet. The study of plant life carries us into the wide realms of Nature—into the fields and woods, the mountains, seas, and deserts, of all lands. It also takes us into the libraries and laboratories of Science, where highly trained botanists grow plants, classify them, cut sections, and peer through powerful microscopes; and so spend weeks, and even years, in studying the structure and life habits of these brothers of ours of the Vegetable Kingdom.

The story of this struggle, of the many ingenious ways in which plants outwit their foes, overcome the obstacles that beset them, and keep their race alive in the midst of perils—this is the story of plant life.

There is hardly a place on earth where plants have not found a home. On the northernmost coast of Greenland, the Arctic poppy peeps out from beneath the ice-cap; and on the dismal reaches of the Antarctic continent, tussock grass and mosses grow wherever a bit of soil is exposed. On the summits of great mountains, buds and

blossoms force their way up through eternal snows. In the heart of the burning deserts, the aloes and the cactus find a way to live. Oceans, rivers, and lakes are filled with an infinite variety of water plants; swamp lands teem with vegetation; and those regions where the plow and the ax have not been at work are mostly covered with great forests or seas of

WHY PLANTS GET SICK

waving grasses. Finally, in the fields and gardens set apart from the "law of the wild," specially selected plants—the aristocracy of the vegetable kingdom-grow fat and multiply under man's guidance.

King Solomon, the Bible tells us, "spake of trees, from the cedar that is in Lebanon even unto the hyssop that springeth out of the wall." But if the "wisest of men" were alive today, it would tax even his brain to keep track of the enormous number of plants that have become known to science. Less than 200 kinds are mentioned in the entire Scriptures, but modern botanists have already recognized and named more than 250,000 plant species. And among these are some that King

Solomon would not have recognized as plants at all; and others of whose existence he could never have dreamed, though they filled the air and the soil about him even as he spoke. Who in those days would have imagined, for instance, that the "leaven" which was used to raise bread, and which the Hebrews had carried with them out of Egypt, consisted of colonies

of yeast plants, too tiny for the eye to see—so tiny indeed that their germs float about on every draft of wind? What would have been the great king's surprise if he had been told that in his own body were similar microscopic plants-the bacteria, some of which were his friends and some

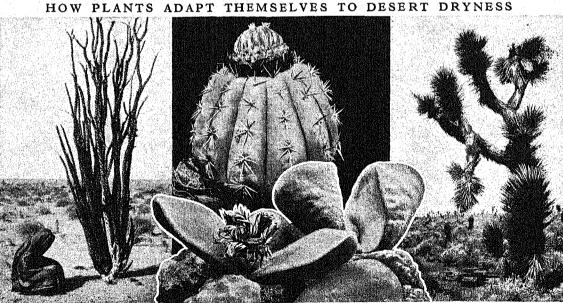
But we cannot criticize the ancients for their lack of knowledge on these points: for it was not until the second half of the 19th century, when the high-powered microscope had

his deadly enemies?

come to the aid of the scientist, that he recognized how much broader were the boundaries of the vegetable kingdom than they had before been imagined.

Plants like human beings have to have certain minerals in their diet, if they are to grow and keep healthy. These are taken up with the water which the roots draw from the soil. Although these minerals are used in very small quantities, they are absolutely essential, as this picture shows. In each of the water jars is a corn plant. They were all started at the same time. But No. 1 lacked all minerals; No. 2 lacked potassium; No. 3, calcium; No. 4, nitrogen; No. 5, phosphorus; No. 6, magnesium; No. 7, iron; while No. 8 had all the required minerals.

5



Desert plants, or "xerophytes," meet arid conditions by special adaptations. The Ocotillo of the American Southwest (left) prevents loss of water by having small leaves, and stems so resinous that Indians use them for candles. The Turk's Cap Cactus of Trinidad, in the center above, has a swollen stem for water storage; while fleshy leaves do the same for the South African Fig Marigold below it. At the right, evaporation is defeated by the narrow thick-skinned leaves of the Tree Yucca of the Mohave Desert.

Added to this was the problem—which has not been entirely solved even today—of distinguishing exactly between the lowest forms of plants and the lowest forms of animals. What are the "slime-molds," for

instance, which creep as white films over damp rotting wood in dark places—plants or animals? Scientists themselves disagree on the answer to this question (see Animal Kingdom).

The next step upward, however, brings us well inside the gates of plantdom. Here we find a great group called the algae, from which all other plants are believed to have These are waterevolved. dwellers as a rule, though some have learned to live in moist places in the open air. The algae include thousands of varieties, from the tiny diatoms with their microscopic but beautifully shaped flinty shells, to the giant kelp of the Pacific, which sometimes measures more than 150 feet from base to tip. The redness of the Red Sea is caused by certain tiny forms of algae, as well as the "red snow" reported by Arctic explorers. More familiar types of these plants form the green "scum" which gathers on the surface of still waters, and those netlike masses of green which wave from their moorings on stones at the bottom of slow-moving brooks (see Algae).

And then we come to the great group of the fungi. These are the "black sheep" of the vegetable kingdom—the outlaws, so to speak. For, although many of them are among the most useful of living things, others are exceedingly harmful -and none of them are governed by regular plant rules. You will know them by their names—the yeasts, molds, mildews, blights, rots, rusts, smuts, mushrooms, toadstools, blackknots, bracket-fungi, and their near relatives, the bacteria or "fission-fungi," as the scientists call them (see Fungi).

Next in order are the mosses, the living carpets of the woods, nature's own upholstery. It may come as a surprise to those who think "moss is just moss" that about 17,000 kinds have already been recognized and named, with probably many more to come. Many interesting things about these "tiny

forests of fairy trees" are told in the article on Moss, particularly the extraordinary manner in which they multiply.

The plants which come next in order you will also find in the shaded woods and on the edges of quiet waters. They are the fern plants, which include not only the true ferns, with their delicate and beautiful fronds, but the horsetails and the clubmosses also. Most of the members of this group have learned to rear themselves above the ground and to stand In fact, when that alone. lesson was learned, millions of years ago, the ferns became the largest of plants; and covered the earth in vast forests, the remains of which form the great coal-beds in the earth today. Although some of the ferns at present grow as big as small trees, the group as a whole has fallen off in size and importance (see Ferns).

The last and greatest group includes all the other plants in the world, distinguished by the name of flowering plants or seed plants. These range in size from the duckweed, no bigger than the head of a pin, to the great eucalyptus of Australia, and the giant sequoia of California, the tallest of all trees. This group contains also more members than all the other plant groups put together, and shows the greatest variety of The algae, form and habit. fungi, mosses, and ferns reproduce themselves either by "fission," which means that one individual plant splits into two new individual plants, by some process of "spore" formation, or by some relatively simple form of the sex act. The flowering or seed plants, on the other hand, multiply generally, as their name would indicate, by the flower and seed method. (See Flowers; Seeds and Spores.)

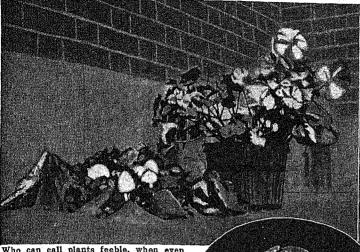


Here we see the "organs" of a typical plant and the work they do. Let's begin at the roots. The main roots grip the ground and hold the plant in place, while the root caps feel their way through the soil in search of molsture. The root hairs draw in this moisture and the minerals it contains, and send them up through the "arteries," which lie beneath the water-proof "skin" of the plant, to the leaves. The leaves not only "breathe in" oxygen from the air but also the major part of the plant's food (carbon dioxide) and digest it with the aid of the water and minerals. The whole structure is held together by the fibrous "skeleton" of stem and branches.

Feelers

(Root-Caps)

FEATS OF STRENGTH THAT NO ANIMAL COULD PERFORM



Who can call plants feeble, when even mushrooms can burst their way through pavements, and trees can split great bowlders? This power of expansion is due to growth and the internal pressure of the sap created, in part at least, by "osmosis." Below is a ripe tomato, burst open by the pressure of sap.

Now that we have made this brief survey of the vegetable world, what quality do we find common to all plants which serves to distinguish

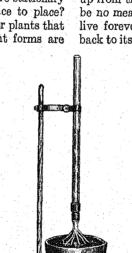
them from animals? Is it that they are stationary creatures, incapable of moving from place to place? Obviously not, for there are many water plants that float about freely, and certain low plant forms are

even capable of swimming about quite actively. No, there is no single quality or mark that stamps all plants, even if we leave out these primitive types, which, as we noted, are so difficult to distinguish from primitive animals.

There is, however, one fundamental plant law—a law which, like so many other laws, is sometimes broken, but which is nevertheless the very foundation and constitution of the plant kingdom. This is the law of greenness.

Of course, you do not need to be told that the vast majority of plants are green. Since the beginning of history poets have sung of the beauty of "earth's green mantle," and green has been the color symbolic of youth and new life. But there are many people to this day who do not realize that the greenness of plants is one of the most important things in the world.

It is the green coloring matter in plants that enables them to take "dead" substances from the air and soil and manufacture living food. In all nature, plants alone can do this.



Here the stem of a plant has been cut off near the roots, and a glass tube has been fastened in its place. Notice how the power of "osmosis" has gradually forced say up into the tube.

Think what this means! Plants produce the very substances on which all other life depends. Without plants, men and animals could not exist, for they would have no food. What about the meat-eaters you ask? But the answer is obvious: If there were no plant-eating creatures, whose bodies are built

up from the substances made by plants, there would be no meat for the meat-eaters to eat. They couldn't live forever on each other. If you trace any food back to its original source, you will find it was made by

a plant. Such things as salt, of course, are not true body-building foods.

What about the plants that have no green color, such as mushrooms? They are the "outlaws" of which we spoke earlier. The whole group of fungi, together with a very few of other plant species, lack this green coloring matter. and so are unable to make their own food. They get their food either from the living bodies of animals and other plants, in which case they are called parasites," or from the decaying remains of animals and plants, in which case they are called "saprophytes." The bacteria of disease, the blights and rusts, the various forms of rot that afflict growing fruit, etc., offer examples of the parasite class; while the mushrooms and toadstools are saprophytes. These two classes of plants are regarded as probably degenerate types which acquired the habit of living on the work of others, and so lost the power of manufacturing their own food.

Outside these two classes all plants contain green coloring matter—even

those algae, such as seaweeds, which have other colors so mixed with it that they appear brown or red.

Photosynthesis

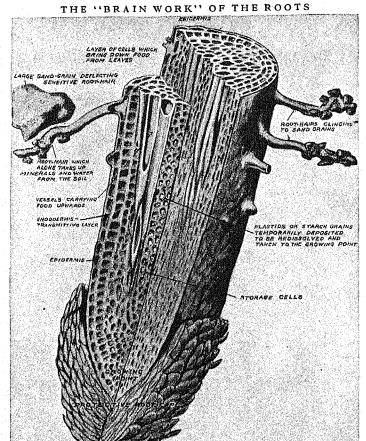
The marvelous green substance which makes plants the greatest factories in the world is called chlorophyll. It is contained in the cells of leaves and often in the stem and With its flowers. aid, the living tissue of the plantthe protoplasm-is able to absorb the energy from sunlight and to use this energy to transform "dead" or inorganic chemicals into "life-giving" or organic chemicals. This is the process called photosynthesis, from Greek words meaning "light" and "put together."

To build living tissues carbon is

required. Where does the plant get its carbon? From the air, where it exists combined with oxygen in a form called "carbon dioxide." This is a gas, produced whenever organic substances are consumed. Thus when coal or wood are consumed by fire, carbon dioxide is produced; and whenever men or animals consume the food fuel of their bodies, the same thing happens. In the latter case, the carbon dioxide is carried by the blood to the lungs and breathed out

into the air, in exchange for oxygen. In both cases the principle is the same—the carbon of the coal or wood and the carbon of the animal tissue unite with oxygen and release energy; in the one case it is the energy of the hot flame, in the other it is the bodily energy (also accompanied by heat) which enables us to live and move.

What has this to do with plants? Everything! For this energy which is released must



When a root-cap encounters an obstacle, the root bends, not at the tip, but higher, showing that the root-cap has "telegraphed" to parts higher up to push it in a different direction. The picture shows a rootlet much enlarged.

carbon to build their own bodies, and absorb energy in the process. The materials of the plant bodies are eaten by men and animals and so built into human and animal tissue. This tissue is used up in active living, and its energy released—carbon dioxide being again formed. The substances with which the carbon from the air

The substances with which the carbon from the air is combined are obtained by the plant from the earth. Water, from which the plant takes hydrogen, is the most important, and with the water there must be

certain minerals needed to build various parts of the plant. These are principally compounds of nitrogen, sulphur, phosphorus, potassium, calcium, magnesium, sodium, and iron.

We must not imagine, however, that plants do not need to breathe just as men and animals do. They need oxygen from the air as well as carbon dioxide; and when they breathe, they also produce carbon dioxide. But during the daylight hours, when

THE CARBON CYCLE

The pictographs on the opposite page illustrate graphically the story told in the text above. The upper pictograph shows not only the main lines of the plant-animal cycle, but also the smaller cycles that take place as the result of plant respiration and the action of micro-organisms in the soil. At the lower left we see how the carbon from plant bodies entering the soil may turn into peat and eventually into coal. When this coal is burned, the results are much the same as if the carbon had been eaten by animals ages earlier. The diagrams at the lower right show how, in the Carbon Cycle, energy is first absorbed and later released.

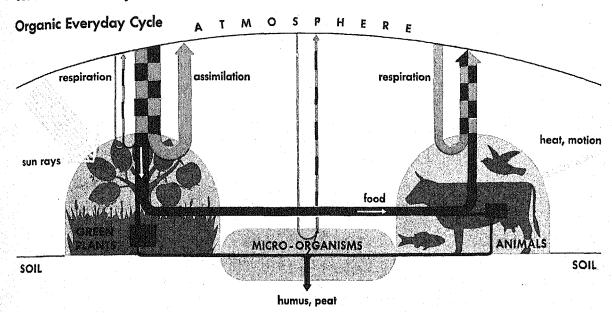
first have been absorbed. And it is this work of absorbing energy which plants perform. By the aid of the chlorophyll, the energy of sunlight separates the carbon from the oxygen in carbon dioxide and helps to manufacture certain organic compounds out of which the plant builds its own body. Now, when that plant body or any part of that plant body—leaves, roots, stems, or fruit-is consumed by being eaten or by being burned, the carbon unites with oxygen again and the energy from the sunlight that was absorbed to build the plant body is turned loose again to perform some other

Thus the carbon cycle is complete. Plants take in carbon dioxide, use the

work.

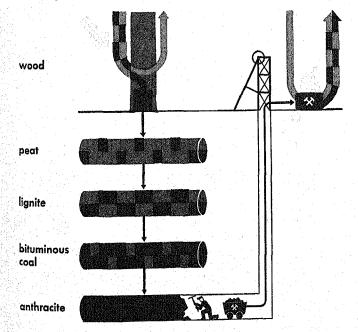
Two Cycles Essential to Life I

The Carbon Cycle



black: carbon compounds containing much carbon (especially carbohydrates)
red: oxygen red and black: carbon dioxide yellow: energy

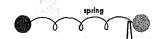
Geological Cycle



Model of carbon - oxygen energy cycle

It is not correct to say: sun energy is stored in coal (or carbohydrates)

sun rays (energy) in action



Energy is needed for separating carbon and oxygen in plants with the help of chlorophyll



A small impulse (d flame) is sufficient to bring both together



The union releases energy

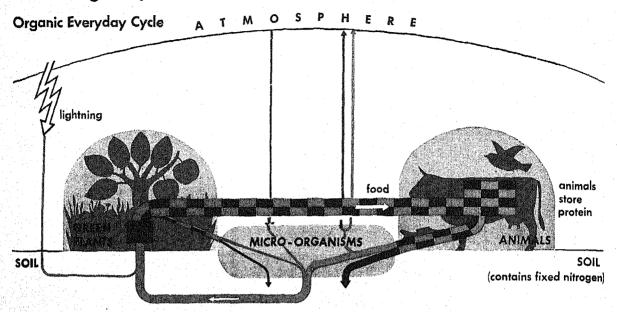
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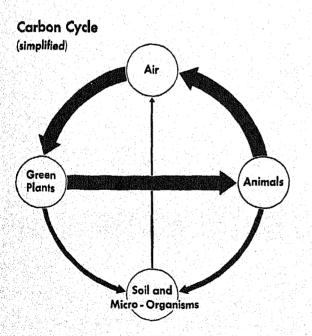


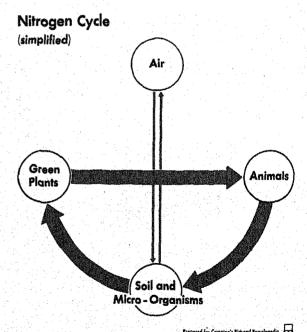
Two Cycles Essential to Life II

The Nitrogen Cycle

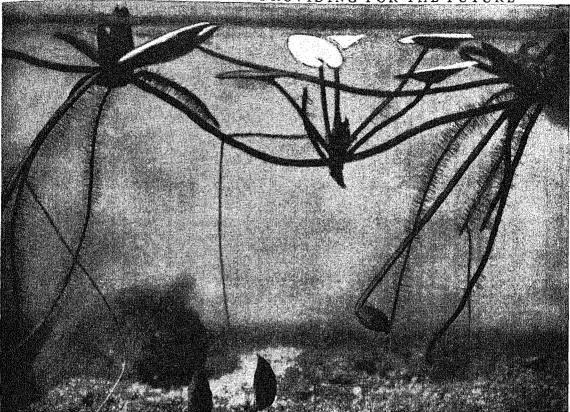


blue: nitrogen violet: nitrogen compounds without carbon black: carbon compounds containing much carbon (especially carbohydrates) violet and black: nitrogen compounds with carbon (proteins)





AN INGENIOUS WAY OF PROVIDING FOR THE FUTURE



This water plant, the Frogbit, is preparing busily for winter. It is stripping itself of all its reserve food, and packing the material into buds on its roots. When full, these buds will drop off and sink into the mud at the bottom, to wait for spring.

they are making their food, they use up all the carbon dioxide that their breathing produces and a great deal more besides, so that a great surplus of oxygen goes out free into the air again. At night, however, when there is no light and therefore the carbon dioxide cannot be broken up in making food, the plant must

get its oxygen from the outside air and must also release a certain quantity of carbon dioxide. In all green plants this breathing is carried on principally by the leaves. Certain saprophyte plants, like the yeasts, which do not live in the air, get the oxygen they need by extracting it from the substances in which they are contained. The changes they cause by taking this oxygen are called fermentation (see Fermentation; Yeast). The next time, therefore, you eat a piece of bread you will know that the little holes that make it so nice and light were caused by the "breathing" of innumerable tiny plants.

THE NITROGEN CYCLE

We have seen on page 238 how the Carbon Cycle is essential to the life of plants and animals. Equally important is the Nitrogen Cycle, for nitrogen is required along with carbon to form the substance of all living cells (see Nitrogen; Proteins). Thus the two cycles actually go hand in hand. The page at the left shows first how plants get simple nitrogen compounds from the soil and unite them with carbon to make proteins. It shows how the animals get the nitrogen they need by eating the plant proteins and how the nitrogen then returns to the soil as waste. And it shows how microorganisms turn the waste back into simple nitrogen compounds which the plants can use once more. The micro-organisms deal with wastes from decaying plants in the same way. Notice that some nitrogen escapes into the atmosphere, but notice also that the supply in the soil is replenished by the action of lightning and by the work of other microorganisms. The lower diagrams compare the essential features of the two cycles.

The way the higher plants draw water from the soil and carry it through stem and branches to the leaves is one of the marvels of science. It can be illustrated as follows: Fasten a small sack made of some membrane (say, parchment) over one end of a long glass tube, and pour into the tube a sugar solution,

such as molasses. Now plunge this end of the tube into a jar of water and fasten it in place. A surprising result will follow. The water will be drawn from the jar through the parchment, and the liquid mixture will rise in the tube until within a few days it reaches a height of two feet or more-all without any visible force or disturbance of any kind. The process is called osmosis. It always takes place when two liquids, one of them containing some other substance in solution, are separated from each other by a suitable membrane: the weaker liquid passes through the membrane and mixes with the stronger.

A TRICK OF THE "DELICIOUS MONSTER"



If the big leaves of this South American plant were solid, the upper ones would cut off light from the lower ones. The plant avoids this by having slits and holes in its upper leaves, letting light through.

This is precisely what happens in plants. Among the things manufactured by the plant from carbon is sugar which is dissolved and distributed in the form of sap through each living cell in the entire plant

structure. The outer covering of the tiny root hairs consists of a very effective membrane, and so do the walls of the individual cells. You can see, then, how by osmosis the water from the ground is drawn into the roots. Various theories are advanced to account for the rising of water in the plant or tree after it has been drawn in by the roots. Osmosis can only account for a part of the process, and one of the best explanations for the remainder of the action is as follows: In the plant there exist connected columns of water from root to leaf. The leaf gives off much of its moisture to the air by transpiration. This probably exerts a "pull" at the top of these columns of water; and the

whole columns move up without breaking, owing to the enormous cohesive power of water.

But whatever may be the explanation, it is enough for us to know that a tremendous force is exerted, often developing a pressure in the sap of a tree of many hundreds of pounds per square inch. It is this pressure which helps to hold young stems and flowers rigid and which causes over-ripe plums to burst. It supplies the energy by which buds and flowers can swell and unfold; by which young roots can force a way through hard soil and even destroy masonry and lift curbstones.

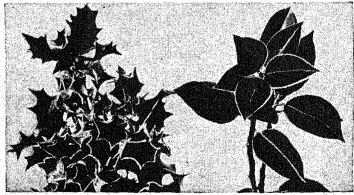
To sum up, then, we may say that green plants eat and breathe principally with their leaves and drink with their roots. They need, above all things, air, sunshine, water, and the minerals from the soil which are dissolved in the water. Next to these bare necessities of life, they must protect themselves and reproduce themselves constantly to prevent their race from dying out.

These facts form the A-B-C of the plant language, which must be learned before we can understand the reasons for the many strange things that plants do. In general we may suppose that all of their curious forms and habits are in some way connected with the business of getting these necessities of life, protecting themselves, and of providing for their young. And we may believe that they were all produced during the millions of years of evolution that

have passed since the first simple algae appeared on the earth.

The soaring trunks of trees, the clinging tendrils of vines, are simply devices evolved by these plants for

THE "INTELLIGENT" HOLLY



The Holly grows thorny leaves near the ground to protect itself against browsing animals, but on the branches beyond the reach of animals it often produces perfectly smooth leaves. The two twigs here are from the same bush.

getting up into the free sunshine and air. The great number of branches with their countless leaves, spread out like so many begging hands, show us how the tree

tries to get as much sunlight on its "skin" as possible. The tough and waterproof bark was developed to protect the delicate tissue inside against the attacks of insects, as well as to prevent the life-giving sap from running out or drying up (see Bark). Thorns are believed to be the result of an effort to drive off browsing animals, which injure the plant. The roots produce sensitive fingers that feel their way

through the soil, dodging around rocks, and picking up moisture which is carried up through the trunk and branches, out through delicate veins to the farthest leaf tip, where it is transformed and carried down again to build up the life cells.

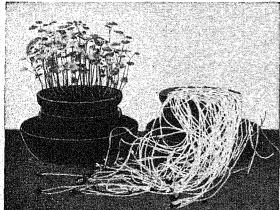
Flowers of brilliant hues, delicate odors, and sweet nectar are grown by the plant to attract those insects which carry the pollen that is necessary for the production of fertile seed. And to make sure that this fertile seed will not fall upon crowded ground and have its young life choked out by older plants, provision is often made for carrying it far away from its parent. Perhaps it has tiny hooks that catch in the fur of roving animals; perhaps it has downy wings or leafy "gliders" on which it drifts with the wind; perhaps it is surrounded with a sweet pulp, forming a fruit which

ground. (See Flowers; Pollination; Seeds and Spores.)
The Struggle of Life in the World of Plants

birds or beasts will carry to some distant planting

The efforts of all plants to obtain as much food as possible for themselves, and to provide properly for their young, produces the great struggle we spoke of earlier. For there is not room enough on the

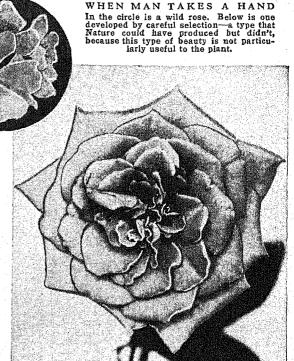
WITH AND WITHOUT LIGHT



The Buckwheat plants on the left were grown in sunlight. The same kind of seed was planted in the right-hand jar, but the plants were grown in the dark.

earth for all the plants and their seeds, nor is there always enough sunshine and water. They must fight for what they get—not by attacking each other as

the animals do—but by pushing and crowding; by sending out the first or the longest roots; by spreading out the highest or the most leaves; by attracting the



most insects or sending out the strongest children; by taking advantage of every opportunity that comes their way, "before the other fellow gets a chance."

In addition to this struggle for room and for food, plants have to battle against heat and cold, drought and flood. Only plants specially adapted can withstand the low temperatures and the long nights of the Polar regions, or find sufficient nourishment in the thin air of high altitudes, or keep their sap running in the dryness of the desert.

Let us consider some of the strange ways in which plants have managed to survive in this constant struggle, first examining some of the ingenious habits that have been developed by plants as a whole.

If you take an ordinary bean and lay it on damp ground, it will sprout, sending a root into the earth and erecting a stem into the air. If you now turn this sprout upside down, so that its root points upward and its stem downward, you will notice in the course of a day or so that the tip of the root has curved over pointing toward the earth again, and the stem has turned upward away from the earth. This curious instinct of the plant, which makes it sensitive to the force of gravitation, so that it will right itself after being upset, is called geotropism, "earth-turning."

Even more curious, perhaps, is the varied sensitiveness of plants to light, called *phototropism*, or "light-turning," or heliotropism, "sun-turning." If a

mustard seed be supported on the surface of a jar of water which contains the necessary minerals for its growth, it will sprout and develop just as if it were

planted in the soil. If the jar is placed in a room some distance from the window, it will grow in a curious way. The stem will bend directly toward the light, the leaves will turn their surface at right angles to the light so that their faces catch the most rays possible, and the submerged roots will turn away from the light. Certain plants in hot countries escape the danger of getting too much heat from the sun by turning the edges of their leaves in its direction, instead of their One of the most faces. striking examples of this is found in the eucalyptus of Australia. But perhaps the most remarkable instance of "vision" in plants is the way the

leaves on a tree will twist and turn and arrange themselves so as to avoid the shadows of the leaves above them. Even the sizes and shapes of the

leaves of different plants are believed to be determined by the amount of light they need. Plants sprouted in the dark remain white, for they have no use for chlorophyll; but they turn green as soon as they are exposed to the light. This peculiarity is made use of in blanching such vegetables as celery and asparagus. The habit in certain plant families—clovers and beans are examples—of drooping their leaves at night, so that it looks as if they had gone to sleep, is an extreme example of phototropism.

If a plant gets plenty of light, it is also bound to get plenty of air, so that the examples of "air-turning" are not conspicuous. Roots, however, need a certain amount of air in their work, and will readily turn toward that part of the soil which is loose enough to be properly aired, provided also it contains the required

minerals. This is a form of *chemotropism* or "chemical turning." A more wonderful example of this,

however, is provided by the breeding habits of ferns. When there is sufficient moisture, their egg cells, which lie on the ground, put forth a sort of acid

which acts upon the freeswimming male cells, drawing them in by chemical attraction.

Most plants are, of course, exceedingly sensitive to moisture and show hydrotropism or "water turning." Drain pipes and sewers are often stopped up by the thirsty roots of poplar trees, which feel their way through crevices in pipes or tiles to get the water they need. Certain plants send down enormously long roots to reach deeply buried moisture, and it seems as if they "knew" beforehand in some mysterious way that the water was there; for at another place which looks exactly the same to us on the sur-

seems as if they "knew" beforehand in some mysterious way that the water was there; for at another place which looks exactly ring time, they fill with air and them.

seems as if they "knew" beforehand in some mysterious way that the water was there; for at another place which looks exactly the same to us on the surface, but which has no hidden water supply, they refuse to grow at all.

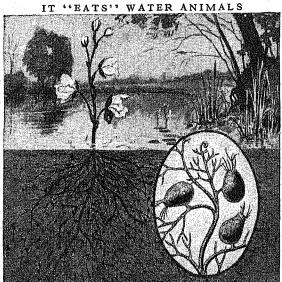
On the other hand, trees growing in swamps, where there is danger of having their roots "drowned" by excess of water, will sometimes raise a portion of the roots above

the soaked ground so they can get air. This is the case of the cypress of southern United States

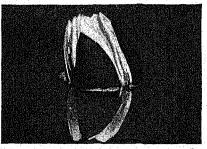
in the cypress swamps.

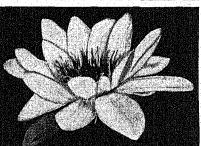
Lastly we come to the remarkable sensitiveness of many plants to touch, sometimes called thigmotropism or "touch turning." Everyone has seen climbing plants send out into the air long tendrils, which start curling around a wire support as soon as they touch it. That this is due to the plant's sense of feeling can be easily proved by a test. Rub one side of the tendril's tip with a small stick or the point of a pencil and it will start to curl in a very short time, though it will straighten out again if you do not repeat the performance. Certain kinds of ivy will even produce new climbing roots at places where a new contact is felt.

In speaking of the sensitiveness of root tips, Charles Darwin wrote: "We believe there is no structure in



The root pouches of the Bladderwort (shown larger in the oval) serve a twofold purpose. Shaped like little lobster pots, they entrap small animals which die and help to nourish the plant during its growth. Then, in flowering time, they fill with air and float the flowers above the water, so the insects can reach and fertilize them.





At the top, the Water Lily is folded up and drawn partly down into the water for the night. Below, it is open for the day. This is an example of the "light-sensitiveness" (phototropism) so common in plants.

plants more wonderful, as far as its functions are concerned, than the tip of the radicle (root). If the tip be lightly pressed or burnt or cut, it transmits an influence to the upper adjoining part, causing it to bend away from the affected side. It is hardly an exaggeration to say that the tip of the radicle thus endowed, and having the power of directing the

movements of adjoining parts, acts like the brain of one of the lower animals."

The well-known "sensitive plant" droops promptly at a touch, at the approach of any red-hot object, at a strongly focused light, at the feel of a drop of acid on its leaves, or even at a loud noise, such as the discharge of a firearm.

But the list of habits showing the response of plants to external stimuli is endless. Let us now turn to those methods by which plants guard themselves against special dangers and adapt themselves to unusual condi-We know tions. that trees constantly exposed to strong winds tend to brace their roots and to strengthen their cellulose skeletons. We also

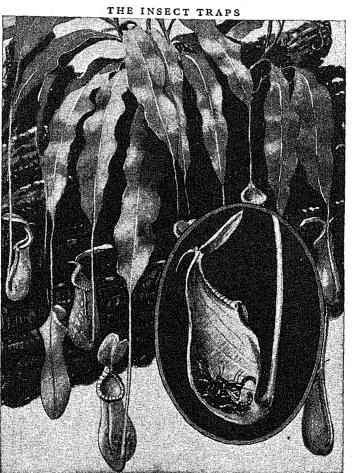
know that evergreens growing in regions of great snowfalls build thicker layers of wood on the under side of their branches, and even alter the arrangement of their branches so that no branch projects far beyond the others—thus making impossible an overload of snow.

Under the influence of extremely dry climates, plants have developed some very ingenious habits concerning water absorption. Some desert plants have produced a stronger sap, which, as we saw in the description of osmosis, enables them to absorb water more powerfully. Others, like the cactus, have developed large cell cavities for storing water. At the same time they have reduced to a minimum their outer surfaces through which water might evaporate,

by losing their leaves and all projections not absolutely necessary to getting light and materials for food making. For the plant moisture escapes through the same tiny openings or "stomata" on the green surfaces which admit carbon dioxide to the plant. Some desert plants have solved the difficulty as to water supply by confining their active life to the short

rainy season, spending the remainder of the year in a half-dried and resting state.

We have seen that nitrogen is one of the important elements which plants must get. They cannot absorb it in its pure state, but must get it in the form of "nitrates" from the soil (see Fertilizers; Nitrogen). Now, wild plants often live in places where nitrates are scarce in the soil. Swamps and bogs are particularly lacking in this respect, for the nitrates dissolve in water and are washed away. To supply this deficiency, certain plants have developed the faculty of catching and eating insects, whose bodies are rich in nitrogen compounds. These are known as "carnivorous plants,"



Most plants suffer from the attacks of insects. The Pitcher Plant, however, hits back. Its "pitchers" are traps in which insects are caught and digested.

and their remarkable behavior is described in the articles on Pitcher Plants, Venus's Fly-Trap, and Sundew. There are water plants, such as the bladderwort, which catch small fish for the same reason. They do this by spreading bladder-shaped nets into which the fish enter, and, being unable to escape, they die. The plant then feeds upon their decaying bodies.

Certain forms of bacteria—which are a form of plant life—have the unusual power of forming nitrates out of pure nitrogen taken from the air. The members of the pea family and other "legumes" (as they are called) have formed an alliance with such bacteria; they colonize them upon their roots, thus making sure of a constant and plentiful nitrate

supply (see Bacteria). In return, the legume supplies its tiny helpers with the carbon-made foods which the bacteria are unable to manufacture for themselves. This is an excellent example of the many forms of natural partnerships in the plant and animal world, which scientists call symbiosis ("life together").

How Long Do Plants Live?

Some plants live only a single season. They are the annuals, which flower the same season they are plant-

ed, and then, throwing all their strength and reserve food into their seeds, wither and die. The biennials make only leaves and buds the first season, and store up food in their underground parts, their upper parts dying down in the winter. Examples are beets, turnips, parsnips, carrots, and many common flowers. The next season the reserve food from the root part is used to make new stems, which bear

flowers and seeds; after which the plants perish completely. The majority of wild plants, however, are perennials, which go on living from year to year. In cold climates they sleep throughout the winter, storing their food in root or stem; in warm climates they

simply keep on growing.

We may say that the very highest plants—and the very lowest—never die a natural death. Such organisms as the bacteria split into two parts, each of which is a new and vigorous life. Thus they form an endless chain, which is only broken by some external accident. Trees, on the other hand, keep on growing in the fullness of their vigor until their very size makes the problem of food and water transmission difficult. Perhaps a weakened branch then breaks off under its own weight, the deadly rot-producing fungi enter through the open wound, and soon the giant is brought to the ground. Under favorable conditions,

however, trees may live for centuries. Certain of the giant sequoias of California have been estimated by scientists to be 3,000 years old or more.

How Plants Store Food

Most plants in favorable locations manufacture much more food than they themselves use up, storing the surplus in various parts of their structure. This makes it possible for men and animals to live, for it is this surplus food of the plants on which we feed.

> directly or indirectly. Sometimes this surplus is found in the foliage of bushes and trees, or in the stems and blades of grasses. Sometimes it is stored in the underground parts, such as roots or bulbs (see Bulbs, Tubers and Rootstocks). Sometimes it takes the form of a supply which the plant has laid by for its offspring, as in seeds and nuts, where a large amount of concentrated nourish-



When these seed pods are ripe, they explode with a loud noise, shooting the seeds far and wide. Hence the peculiar name of the South American plant which produces them.

ment surrounds the plant germ. (See also Plants in FACT-INDEX at the end of this volume.)

How Plants Are Classified

The following is a useful classification of the members of the plant kingdom:

Group I. Thallophytes, including algae, fungi, bacteria, lichens.

Group II. Bryophytes, including liverworts and mosses. Group III. Pteridophytes, including ferns, horsetails, and

Group IV. Spermatophytes, or seed-producing plants.

(1) Gymnosperms, such as pines, spruces, hemlocks, juni-

pers, cedars.
(2) Angiosperms, the true flowering plants. These were the latest plants to be developed in the history of the earth, and they have the most complicated structures. They are

divided into:
(a) Monocotyledons, such as cat-tails, pond-weeds, grasses, sedges, palms, lilies, orchids.

(b) Dicotyledons, including many herbs and shrubs, and such trees as poplar, oak, hickory, elm, willow.

What Men Do with Plants

The Many Uses of Plants OF ALL LIVING creatures, men are the most lavish users of plants. Lower animals merely eat plants or use them for shelter. Men do the same, but they

also make plants serve them in countless other ways. Here are the main ways in which plants help us.

We eat plants. The chief use men make of plants is for food. In North America the most important food plants are the cereal grains, named for Ceres, the Roman goddess of agriculture. The saying "Corn is King" is due to the tremendous amount of this grain raised for feeding men and animals, and for many industrial purposes. Next in quantity is wheat. Other great cereal crops are oats, rice, barley, rye, and buck-

wheat. The crops of vegetables and fruits are also large and diversified, giving the people of North America a greater variety of food than is enjoyed by the people of any other region in the world. (See Reference-Outline with the article Agriculture.)

Food plants raised in other parts of the world come to North America in fleets of ships. We get bananas from Central and South America, coconut oil from the islands of the South Pacific, dates from Iraq, and a host of plant delicacies from other regions.

Many plant foods are processed; that is, manufactured into purer forms. Sugar, flour, and the vegetable oils are examples of processed foods. Canning is another form of processing (see Canning Industry).

We drink plants. How tastefully water blends with the flavors produced in the cells of plants! Many of these beverages are ready-mixed by nature; coconut milk, apple eider, citrus and grape juices, nectars of apricots and other fruits, are examples. Other drinks, such as coffee, cocoa, and tea, are prepared by steeping plant substances in hot water. Still others come from processed plants, as the "cola" drinks from the kola nut of tropical America. Many of our "soft" drinks are mixtures of some plant juice for flavor, sugar for sweetness, and carbonated water to

make the "fizz." The "hard" drinks contain alcohol, fermented from any sweet or starchy plant through the agency of other plants, the yeasts.

We wear plants. Cotton is the chief plant used for clothing. From the flax plant we make our linen. The rayons, artificial fibers that resemble silk, are manufactured from wood or cotton fibers (see Rayon). A century ago plants furnished most of the dyestuffs with which cloth was colored, but today nearly all these dyes are manufactured from substances found in coal tar.

We are sheltered by plants. Shelter in North America is typically provided by a plant product—wood. In this region there are more walls of wood than of days. From these "simples" the village doctor made mixtures which he called "compounds." Today we call them drugs, an Anglo-Saxon word for "dry," although many are pastes or liquids (see Drugs). Many of these plant drugs are mild, and safe to take without a doctor's advice, but others are violent poisons (see Poisonous Plants).

The chief drug plants of North America are boneset, cascara sagrada, ginseng, golden seal, hellebore, hepatica, mullein, pennyroyal, white pine, pleurisy root, sarsaparilla, senna, witch hazel. From Peru

CHINESE "IMMIGRANTS" NATURALIZED IN AMERICA



At the top is a Louisiana orchard of tung trees. Tung oil, invaluable in mixing paints, is extracted from their nuts. At the left is an Illinois field of soy beans (see Soy Bean).

comes quinine; from Formosa, camphor; from China, opium; from India, nux vomica; from Europe, belladonna.

We read, write, and wrap with plants. The people of North America use more than half of all the world's paper. One day's issue of their newspapers requires spruce trees cut from hundreds of forest acres in the northern regions. One day's wrapping and sacking of purchased goods requires pine trees cut from hundreds of acres in the southern regions, where kraft paper is manufactured. Even the better papers, for books and letters, are mixtures of wood pulp and linen fiber. A surprising amount of paper is made into cardboard, roofing paper, insulation for electric wires, and filters for air-conditioning (see Paper).

We burn plants for fuel. Wood continues to be the most convenient fuel for many homes. Charcoal, a wood product, is also a favorite for special types of burners, such as are carried on picnics. It must not be forgotten, too, that coal has been formed from plants that grew long ago. (See Charcoal; Coal.)

We play with plants. Can you name a game that does not use wood in some form? Think of tennis rackets, baseball bats, croquet mallets, bows and arrows! Basketball is played on wooden floors and football has wooden goal posts. If "playing" is extended



brick or stone, more roofs of wood than of slate or tile, more floors of wood than of cement, steel, or bare earth. Within the home, the furniture and the conveniences of living are chiefly of wood or plantfiber cloth. The wall covering is usually paper; the paints are dried films of linseed oil; and the linoleum is a mixture of linseed oil and cork.

We take plants as medicines. By experimenting throughout the ages men found that certain plants would relieve their aches and pains. Boneset, catnip, horehound, pennyroyal, sage, and other such plants used to be dried in attics and over fireplaces for home use. They were called "simples" in the olden



to refer to music, we recall that stringed instruments, wood winds, and drums are largely wood.

We manufacture from plants. Wood was the first raw material men used in handicrafts. From it they carved rough tools and weapons, they attached shafts of it to stone spearpoints and arrowheads, and they bent it into bows. Today wood is employed in a host of useful forms of every type from telegraph poles to toothpicks, and from railway trestles to kite frames. From wood men make boats, vehicles, and airplanes.

Trees that yield some special products are numerous; read, for examples, the articles on Chewing Gum, Cork, Rubber, and Turpentine. Many food crops have important uses in factories; from corn come industrial starches, gums, glues, oil (see Corn). A useful plastic is made from soy beans; others are made from cotton (see Plastics). Most perfumes were originally from plants, although today's chemists are clever at imitations (see Perfumes). The list of useful products made from plants might be expanded indefinitely.

Agriculture—a Supply of Economic Plants
Those plants which men have found useful are called
economic plants. Out of several hundred thousand dif-

THE "CHOCOLATE TREE" STAYS IN THE TROPICS



A native of tropical America, the cacao tree has been transplanted to other hot, moist lands. But other regions must import the beaus from which chocolate and cocoa are made.

ferent kinds of plants, only about 200 different kinds are eaten; out of fully 1,500 different plant fibers that men have tested, only about 20 can be made into comfortable clothing. But men do not limit the list of economic plants merely to those that furnish the necessities and conveniences of daily life. They extend the list to include the trees, shrubs, and grasses that help to make pleasant surroundings, and they consider "economic" even the colorful and scented beauties of the gardens, worth so little to those who do not love flowers, and so much to those who do.

The Beginnings of Agriculture

How did agriculture begin? Back in the very ancient past, the fruits, nuts, and berries of the forests and thickets provided food. Later, men learned to dig roots and scrape or pound them to a paste for eating. Still later the idea of cooking this paste, and certain juicy stems and leaves, came from campfire experiments. Men found that not every plant may be eaten; some tasted bitter, and others had unpleasant effects after they were swallowed.

It probably did not take ancient men long to learn that certain barks, slender stems, and vines could be twisted together into cords for fishing, for tying captured animals, and for making baskets. Slowly came the practise of spinning threads and weaving cloth from these wild fibers. The distaff and the loom were

among the first inventions.

As the centuries passed, the more clever tribes selected certain wild plants for taming, and began the practise of husbandry, which means "keeping near the house" in the old Anglo-Saxon language. No longer was it necessary to roam far and wide to find food. Thus began one of the chief occupations of men—agriculture. Seeds from plants pleasant and safe to eat were planted, their young growth protected from weeds, and methods of storing harvests through the winter were devised.

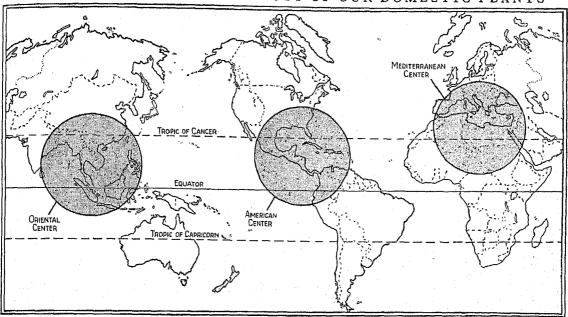
Agriculture—and civilization along with it—developed from three distinct centers of the world: the Mediterranean, the American, the Oriental.

The Mediterranean center included those shores where the three great continents—Africa, Asia, Europe—meet. Up to two or three centuries ago the Mediterranean peoples planted more different kinds of food than did the dwellers in any other part of the world. They also raised textile fibers. Among their crops were apples, carrots, celery, chestnuts, coffee, cotton, dates, figs, flax, lemons, lettuce, mustard, olives, onions, peas, plums, sugar cane, turnips, walnuts, wheat.

The American center included the narrow region of Central America, and the wider lands to the north (now Mexico) and south (now Colombia-Venezuela). In these lands men learned how to raise cacao (chocolate), corn (maize), cotton, kidney and lima beans, peanuts, pineapples, potatoes (sweet and white), pumpkins, squash, tomatoes, and vanilla.

The Oriental center included all of eastern China, Indo-China, Malaya, Japan, Korea, and the Pacific

THE ORIGINAL HOMES OF MOST OF OUR DOMESTIC PLANTS



We do not know where the wild ancestors of many of our useful plants were first discovered. But the map shows where most of these plants were first cultivated as staple crops. From these centers they were carried to other lands. The text on the preceding page tells which plants came from each of the great centers. Some, like cotton, were developed in all three.

Islands. In these regions men of ancient times grew cotton, oranges, peaches, rice, soy beans, tea, yams, and a few others. The Orient has lacked variety in its foods from the earliest times to the present.

Most of the plants that a few centuries ago were grown in only a single part of the world are now cultivated in any place where climate and soil permit. There is also much traffic in foods and fibers across continents and even oceans—from places of favorable growing to the crowded centers where there are many to be fed and clothed.

Plant Hunters and Their Work

When white men first came to the land that is now the eastern coast of the United States, only a few of the 80 chief crops now raised were to be found. The Indians were cultivating, after a fashion, small areas of beans, crab apples, corn, pecans, pumpkins, raspberries, squash, sweet potatoes, and tobacco. Tomatoes were also grown, but the white man feared to eat them. New settlers from Europe usually brought seeds of their own favorite crops, and found that nearly all of them would thrive in the New World. Most of the grains except corn, most of the garden vegetables, and many of the fruits were newcomers to America as truly as were the colonists.

In 1827 President John Quincy Adams instructed the United States consuls to send home any seeds and plants that might become useful crops in North America. Later administrations expanded this service, and today the Division of Foreign Plant Introduction of the Department of Agriculture sends its specialists all over the world seeking for new plants or better varieties of plants. The experiences of these "plant hunters" in the wildest parts of Asia, Africa, and South America are tales of adventure as thrilling as those told by seekers after gold or wild animals. Although the expenses of these experts may be only \$200,000 a year, the value of their discoveries may be worth \$100,000,000 a year to American farmers. Improved strains of durum wheat from Russia, barley from Turkey, drought-resistant grasses from India, and soy beans from Manchuria are typical of the better crops made possible by the plant explorers. (See also Agriculture.)

Chemurgy Finds New Ways to Use Plants

In 1935 the first Farm Chemurgic Council was held at Dearborn, Mich., and one or more meetings each year have followed. The word chemurgy (kěm'ūr-jž) means "chemistry at work." The council included three groups of experts—in agriculture, in industry, and in science. The latter were chiefly chemists. The chief purpose of the Chemurgic Councils has been to devise non-food uses for farm products. Chemists, especially, have found ways for manufacturers to use more of the crops that farmers raise. The most important chemurgic principles are these:

1. Surplus food crops should be used in manufactures. Many farm crops are often grown in greater quantities than can be eaten. Studies on the use of soybean oil for paints and lacquers, and soybean meal for plastics, are examples of chemurgic projects.

2. Land that is too poor, too wet, too dry, or otherwise unsuitable for food crops may raise other plants profitably. One of the leaders of the Chemurgic Council, Dr. Charles H. Herty of Georgia, by experiments in his laboratory at Savannah found ways to make news-

RID AMPRILIE

print from the pines of southern forests. These had been considered too full of resin for the manufacture of any paper other than kraft—brown wrapping paper. His discoveries resulted in new, large newsprint mills near the Gulf Coast, where pine trees grow rapidly.

3. Plant wastes

LEADER IN CHEMURGY



Charles H. Herty gave the South a new industry by finding how to make paper from slash pine wood. He is shown putting a log into a pulping machine.

into profitable materials. Industrial alcohol may be fermented from sugarcane tops, poorly shaped fruits, undersized potatoes, and many other "culls" unsuited for sale as food. A blend of this alcohol with gasoline has been successfully marketed as a motor fuel in several states. Scrap lumber, limbs, slabs, and other waste wood are chipped, steamed under great pressure, then exploded into a fluffy mass called lignocellulose; this is compressed into

should be turned

boards and panels that take the place of lumber. The largest mill producing this product, called masonite, is in Laurel, Miss. Another waste produced in great quantity on North American farms is wheat straw. This is now being used to make cardboard cartons, egg cases, tablet backs, and the like.

4. Certain small crops should have larger uses. The Jerusalem artichoke of the midwestern states—a sunflower—has a rough root that was prized by the Indians but despised by the white settlers as food. This starchy root is an excellent source of alcohol for industrial uses. Castor oil from castor beans has been converted by chemical treatment into an oil with satisfactory drying qualities for varnishes and lacquers.

5. Certain crops should be planted in North America to provide raw materials now imported from Africa, Asia, and Europe. Textile starch, used on all cotton threads, is being made from Mississippi sweet potatoes to supplant starch shipped from Java. Tung oil is pressed from the nuts of tung trees that grow well along the Gulf Coast, taking the place of some of the tung oil shipped from China. Flax of a special type to make the thinnest cigarette paper is now growing in North Carolina, whereas all this paper formerly came from France. Peanut hulls prove satisfactory as insulation for refrigerators, replacing cork imported from Spain.

A pioneer chemurgist was the noted Negro chemist, George Washington Carver of Tuskegee Institute. He prepared nearly 200 different products from peanuts, more than 100 from sweet potatoes, and scores of paints, inks, greases, medicines, and other useful things from common farm plants. His ideas of non-food uses for farm crops are the foundation of chemurgy.

How Diseases of Plants Are Cured or Prevented PLANTS, LIKE ANIMALS and people, have their ailments, and wither or die even when they have sunshine and rain. There

are five chief causes of sickness in plants; for each, gardeners and farmers have remedies that are more or less efficient.

Fungus diseases of plants are very common. The fungi usually dwell as parasites upon the plants, sending tiny root-threads into their tissues (see Fungi; Parasites). Although there are dignified scientific terms for the fungus diseases, these infections are commonly known by descriptive names such as blight, mildew, mold, rot, rust, scab, smut, spot, and wilt. The fungi can be killed by steeping the seeds in antiseptics (as formaldehyde), or spraying the plants with compounds of arsenic, copper, lead, and some other metals (see Spraying).

Virus diseases of plants spread more rapidly than any others. A virus is a producer of disease that is too small to be seen with even the best of microscopes. Because the virus makes peculiar patches on the leaves, its effects on plants are called mosaic diseases. Potato, tobacco, and tomato mosaics are the most common. (Familiar virus diseases of humans are smallpox, rabies, yellow fever, and probably infantile paralysis, influenza, and common colds.)

For many years it was not known whether a virus was a living plant (as fungi) or an animal (as protozoa) or a lifeless chemical (as an enzyme). About 1937 the virus of tobacco mosaic was obtained in the form of white crystals that could be seen, and thus it was proved to be a lifeless chemical. It is a protein with

FAMOUS NEGRO PLANT CHEMIST



In his simple laboratory, working mostly with home-made equipment, George Washington Carver discovered how to make hundreds of new products from the peanut and the sweet potato.

an exceedingly large molecule, and an amazingly small amount of it produces mosaic disease in a healthy plant. These investigations have revealed a new marvel—crystals that are dead but have the power of multiplying like living things when they touch the tissues of their victim. Mosaic diseases are fought best by burning the infected plants.

Soil deficiencies may cause diseases of plants. Certain minerals that the roots gather for food are needed in large amounts, others in very small amounts. The lack of any necessary chemical element in the soil will prevent the healthy growth of the plant. For example, if leaves show a pallor, called *chlorosis*, it may be due to a need for the extremely small quantity of iron necessary to form green chlorophyll. Soil deficiencies in the chief mineral foods of plants are usually supplied by fertilizers, but it is not always

easy to determine which of the minerals needed in very small amounts may be missing. (See Fertilizers; Soil.)

Insect eggs and larvae damage plants. Laid on or under the bark, on the leaves, or elsewhere, the eggs hatch into larvae which eat up the leaves or bore into the wood (see Insects). In other instances, diseases termed galls and scales are produced (see Scale Insects). Treatment for insect pests usually involves spraying, although in some instances a harmless insect that feeds upon the harmful one can be found. (See Ichneumon Flies; Lady-Bug.)

Plants are wounded by storms, animals, and men. Everyone has seen some great gash cut into the bark of a tree, reaching to the living wood beneath.

The best aid men can give to valuable plants is to paint the wounds with some antiseptic, and protect them from further injury by wrapping. (See Tree Surgery.)

Self-Healing of Plants

It is often said of human diseases: "Nature is the best physician." This is also true of plant diseases. The corky layer that soon covers the wounds of a healthy tree is a perfect cure. It has been indicated by some experiments on corn that plants may develop in their tissues a bacteriophage or "germ killer" similar in effect at least to the antitoxins that develop in the blood of animals (see Bacteria).

Another lesson learned by humans for the protection of their own health may also be applied to plants: those with a strong constitution resist diseases to which the weak succumb. Good food from rich soil makes healthy plants, as a rule.

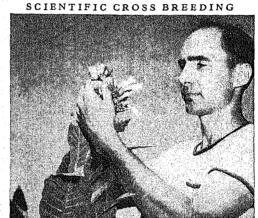
Certain strains of plants have a natural immunity to disease. An observant farmer in Manitoba picked one head of wheat from a rust-free plant in a field of rusty wheat. He saved the seed, increased it by planting, and in a few years had plenty of seed for raising rust-resisting wheat. (See also Plant Diseases in Fact-Index at the end of this volume.)

How Men Improve Plants "PLANT WIZARDS" they are often called, but plant breeders use no magic—only patience, persistence, and much knowledge of plants. They have two

aims—to maintain, and to improve, the quality of economic plants. Their work is based on nature's fundamental law of heredity, stated most simply in Mendel's Laws (see Heredity). Left to natural forces, good plants may "run out" in quality. Some plants would die altogether, and those remaining by "natural selection" might be of little benefit to men. A plant breeder replaces "natural selection" with scientific selection of the best, and lets the poorest die. He also "makes plants to order," by breeding to obtain plants with certain desired qualities.

This is done chiefly by cross breeding. The plant breeder begins with a plant that has as many as pos-

sible of the desired qualities. Then he chooses a second plant in which one of the qualities lacking in the first plant is verv strongly developed. When the flowers of both plants become mature, he takes the pollen (male element) from the second plant and dusts it on the pistil (female element) of the first plant. He hopes that the



An expert of the U.S. Bureau of Plant Industry is creating a new variety of tobacco by cross pollination.

seed which then develops in the first plant will inherit the new quality he is looking for. If it does so, he may then try to "fix" the new quality permanently by inbreeding plants grown from the new seed for several generations. This means that the blossoms of the new plants are fertilized with their own pollen. From each succeeding generation of plants so produced, he selects as parents of the next generation those that most successfully have kept both the old and the new qualities he desires.

When a plant is finally "breeding true" with the good qualities the breeder sought, then he must have its seed tested in various parts of the country where it might grow, in different soils and climates. Other tests may be made on the uses of the plant's products, such as baking tests for grains or cooking tests for fruits. (For the work of a great plant breeder, see Burbank, Luther.)

What kinds of improvements are sought in "made-to-order" plants? Most important, perhaps, is the breeding of hardiness—resistance to cold, to drought, to disease.

When a parent growing in a cold region is cross-pollinated with a parent growing in a warm region, the offspring may become better adapted to endure unexpected winters. A single plant observed to resist rust or smut is bred to one that has a better yield, and some of the resulting plants will have high yield and also resist disease. Practically all the seeds of grains, garden vegetables, and other seed plants sold by seedmen are of some hardy variety.

Plants are also made richer by the breeder's patient skill. Sugar beets had their sugar content more than doubled by breeding. Sweeter fruits, a tobacco stronger in nicotine, and soy beans with more oil are similar achievements. Plants are made to mature earlier or later by selecting parents with those qualities. Thorns have been removed from berry bushes, needles from cacti, and beards from wheat. Fruits and vegetables have been given more desirable colors, flavors, odors, keeping qualities, cooking qualities, and even higher vitamin content. Tomatoes have been given tougher skins for shipping, and more tender skins for canning. Carrots have been given long slim shapes and a richer color. Potatoes have been "streamlined" until their "eyes" are hardly visible and the smooth skin is ideal for peeling. Cucumbers have been made larger for giant pickles, and watermelons smaller to fit in the modern refrigerator.

Flower gardens bear witness to some of the most amazing achievements of plant breeding. New colors, sizes, and shapes of familiar flowers are displayed in every catalog of the seedmen-florists.

In 1930 the United States Congress recognized the breeder of new plants as an "inventor" and passed a law offering him the protection of a United States patent for his product. An everblooming rose, named "New Dawn," was the first patented plant (1931), and for 17 years all nurserymen who sell this rose must pay a royalty to its originator (see Patents). The laws do not permit a grower to patent any variety that nature has already developed or might produce without the aid of man. About two-thirds of the plants now patented are flowers; most of the others are fruits and berries.

The plant breeder works also with cuttings and graftings, especially when he is improving vines and fruit trees; but no permanent changes in the heredity of a useful plant are likely except through the seeds.

Auxins for Growth

Scientists have recently found ways to speed up plant growth astonishingly. They have discovered auxins, the substances that make plants grow. Auxins—the word means "helpers," or "promoters"—are members of the hormone family. Animal hormones are secreted in special closed (duetless) glands situated in various parts of the body (see Glands). They make humans tall or short, fat or lean, strong or weak, quick or slow in motion or in thought—in short, they influence our entire personalities. The animal hormones were discovered about 1900, but plant hormones, or auxins, were not discovered until about 1925.

Auxins are produced at the very tips of growing leaves or buds. They ooze back short distances to growing cells of leaves or stems and stimulate these cells to grow longer. Each large cell finally divides into two smaller ones, which in turn are lengthened by the auxin that soaks into them. All this was proved when botanists stopped the growth of oat seedlings by cutting off the very tips of the plants, and then started it again by rubbing juice from the tips into the cut ends.

Light destroys or weakens auxins; hence if one side of a tip is lighted the other side of the stem below it grows faster, and bends the stem toward the light. Thus for the first time *phototropism* of plants was explained.

Artificial Auxins

In 1934 a Dutch plant physiologist discovered how to prepare a powerful growth-promoting substance from various plant products, such as the malt extract made from sprouting barley. This he called heteroauxin-the word meaning "helper of different plants." When heteroauxin is mixed with lanolin (wool fat) to make a salve and is rubbed on any part of a plant, cells grow to great lengths in a few days, forming rootlets. Soon (1935) workers at the noted Boyce-Thompson Institute, Yonkers, N. Y., discovered that certain synthetic chemicals would grow roots in the same fashion. These chemicals, chiefly derivatives of indole (C₈H₇N) such as indole-acetic acid, indolepropionic acid, and indolebutyric acid, were soon on the market -and then "everybody began growing whiskers (roots) on plants with magic ointment"! Roots were developed on stems and leaves. One experimenter grew roots on the petals of lilies!

Commercial auxin is manufactured and marketed under various trade names such as Auxilin and Hormodin A. It is expensive but for use it is usually diluted 6,000 times with water. Its practical service is to help gardeners in rooting cuttings that stubbornly refuse to send roots out in ordinary water or damp sand. Camellia shrubs, lemon trees, holly, and other unresponsive cuttings cannot resist the power of auxin. Its astonishing effect on holly is illustrated in the following picture which compares a group of treated and a group of untreated twigs:



An astonishing result followed the application of auxin salve to the pistils of tomato blossoms. The blossoms produced ripe fruit, even though no pollen had fertilized them. These "fatherless tomatoes" encouraged similar experiments with other plants.

At the plant laboratories of the California Institute of Technology, Pasadena, plant physiologists experimented with other chemicals to stimulate root growth. They found that a solution of yeast extract, containing vitamin B₁, proved to be a wonder-worker.

Vitamin B₁, Developer of Plants

It is amazing how little of this vitamin (also called thiamin chloride) is required to give a plant a new reason for living. A tiny portion of the white powder no larger than the head of a pin is dissolved in 20 drops of water. Then one drop of this solution is stirred into one gallon of water. Even with this, the warning is given, "Do not use too much!" About one part of this vitamin to 100 million parts of water is the best strength.

Vitamin B₁ produces larger, healthier plants, with flowers of striking size. Five-inch rose buds, snapdragons six feet high, have been reported. A narcissus grew as tall as a boy in one season. Tiny cuttings and seedlings develop at an unusual rate. Plants that will not bloom—often for no apparent reason—change their minds and produce blossoms. Plants that are stunted take on new life; sick plants regain health. This vitamin has saved the lives of large trees that seemed about to die.

If the roots of a transplanted potted plant, shrub, or tree are soaked in the weak solution of vitamin B₁ just before being put into the new soil, root-shock does not occur, and one may say, "The plant does not know it has been moved."

Colchicine, the Wonder Drug

In 1939 Dr. Albert F. Blakeslee of Cold Spring Harbor, N. Y., announced the amazing results on plants of colchicine $(k\delta l'ch\ell-s\bar{e}n)$ sprayed upon their leaves. Colchicine is extracted from the seeds of the wild meadow saffron, which botanists call Colchicum autumnale. Although named after Colchis, an ancient province of Asia east of the Black Sea, this plant was also known to the Aztecs of Central America, who used it as a poison. Early settlers in the United States used weak preparations of it as a remedy for rheumatism and gout. Colchicine is one of the plant poisons called alkaloids and has the chemical formula $C_{22}H_{25}NO_6$.

Dr. Blakeslee's first experiments with colchicine were on jimson weeds, but later he and others sprayed the leaves of tobacco, lettuce, and many berries, fruits, and flowers. He found that this alkaloid, when absorbed by the leaves of rapidly growing plants, caused a doubling of the chromosomes—those carriers of heredity in all dividing plant cells (see Cell). This property gives the plant breeders many advantages. Twice as many good qualities can be bred into a plant treated with colchicine—though of course twice as many bad qualities may also result. Crosses or hybrids of plants not closely related have been made strong and fertile, whereas without colchicine such crosses are usually weak and incapable of producing offspring. These hybrids are entirely new plants never grown before!

A brilliant orange marigold, much larger than its ancestors, was the first "colchicine flower" produced. It was named "Tetra" because it has four genes in



groups of four instead of the usual two. The picture at the left shows how the big Tetra blossom compares with a blossom of the Guinea Gold variety. The Tetra "breeds true"—that is, its seeds produce blossoms of the new size and color. A hybrid cotton has been produced that combines the long fibers of late-maturing cotton with the early maturity of a short-fibered variety.

Other improvements are crosses of the loganberry and blackberry, and crosses of a far northern blackberry with a far southern type to obtain the best variety for a moderate climate.

Dr. Blakeslee also found ways to halve the number of chromosomes instead of doubling them. He and others have become jugglers of heredity in plants, doing things that nature could not bring about.

Other Ways of Influencing Plant Growth

Experimenters have tried out an amazing number of other methods to change the behavior of plants. X-ray bombardment of seeds has produced astonishing changes because of the effect upon the chromosomes. Short-wave radio waves stunted the growth of corn seedlings or killed them. Neutron bombardment produced one-sided leaves or affected the germination of plants. It has been found that the gradual lengthening of lighted hours in a greenhouse will cause spring-flowering plants to bloom at any season, while the gradual shortening of the lighted hours day after day will bring forth blossoms on fall-flowering plants. Warming the soil by electric cables seems to have helped certain plants to an earlier start in the spring.

Successful gardeners are often said to have a "green thumb," because the plants they set out always seem to grow well. It is more likely that these gardeners are merely more observant, more patient, more scientific than are the others who have poor luck. These better gardeners are the ones the scientists—botanists, plant physiologists, plant breeders, chemists, and others—can help the most. (See also Plant Improvement in Fact-Index at the end of this volume.)

Hydroponics— Growing Plants Without Soil FAR OUT IN THE Pacific Ocean lies Wake Island. This island is in actual fact "a thousand miles from nowhere," because its

next neighbor is 1,028 miles away (see map with article Pacific Ocean). For centuries only the sea birds and turtles made prints in its sands. Then huge wings

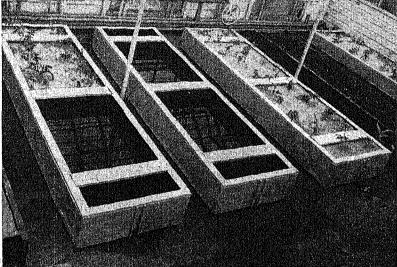


of the Pacific Clippers—flying boats between California and China—began to drop in a sheltered bay. Before war struck this outpost, men of peace were living there the year round. Passengers from the flying boats stopped overnight. And the food included a rich variety of fresh vegetables.

dening and dirtless farming and tank farming and tray agriculture have been the titles of many magazine articles about the plan, while those with a sense of humor speak of bathtub gardens.

The chief concern of any gardener is to feed his hungry plants. Rich soil contains the right foods,

HYDROPONICS-HOW TO GROW PLANTS WITHOUT SOIL

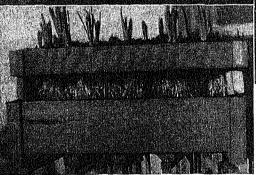


But how may fresh vegetables be obtained upon a shell-strewn island "a thousand miles from nowhere"?

Not many months before the Clippers began to fly the Pacific, Dr. W. F. Gericke of the University of California began to reap huge crops of fresh vegetables grown on small areasentirely withoutsoil. The roots of his plants dipped into wooden and metal tanks containing solutions of the chemicals that are their food. To-

day, on about half an acre of tanks upon Wake Island, flourishing gardens yield tomatoes, potatoes, melons, carrots, beets, lettuce, cabbage, and other vegetables and fruits.

What is this plan by which one may have a garden anywhere that air and sunshine may be found? Although thousands of people are trying the plan for pleasure or profit, no name for it has been agreed upon. Dr. Gericke prefers the name hydroponics—from Greek words that mean "water gardening." Since only chemicals are used, the term chemiculture ("growing with chemicals") has been suggested, to contrast with agriculture ("growing in fields"). Soilless gar-



The picture at the upper left shows three tanks used in chemical gardening. One of them contains only the solution; another is partly covered with excelsior in which tomato plants are growing. In the third tank the planting is completed. In the next picture at the right Dr. W. F. Gericke, pioneer of hydroponics, holds a small wooden tank which anyone can build for home or classroom use. The lower picture shows how the plant roots grow down through the screen to reach the chemical solution.

and for centuries it was thought that the soil was their only source. Since black soil seemed richer than light soil, the humus or organic matter from decayed plants was also thought to be a food for living plants. (See also Soil.)

These ideas were proved to be largely wrong when a noted German plant physiologist, Julius von Sachs, about 1870 began

growing plants in water, to which he added a few minerals. He found that plant roots needed other chemicals for food than the three chief ones—nitrogen, phosphorus, potassium. To these he added calcium, magnesium, iron. Later workers have increased the list to about 20. Of some—like copper and boron—only the smallest traces are required. The chief value of black soil, we now know, is that it holds moisture better than do the light soils, and permits less leaching (washing away) of minerals.

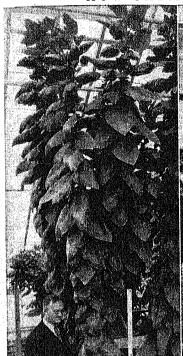
Various Water-Culture Methods

Although water cultures have been common in plant laboratories for decades, it was the work of Dr. GerM. Dramprolix

icke that attracted the attention of the gardening world. In his method, a shallow layer of loose excelsior lies upon coarse-meshed screen wire (such as chicken fence). In this the small plants are anchored. Their roots extend down into shallow trays of wood or metal, filled with hydrant water to which the proper

Subirrigation was devised by Dr. Alex Laurie of Ohio State University, Columbus. Shallow, watertight tanks are filled with coarse gravel or cinders, and in these the plants are set. Twice a day the solution of minerals flows in from below, filling the tank; after a few minutes it is drained away. Raising and lower-

HOW CHEMICAL GARDENING IS PUT TO WORK

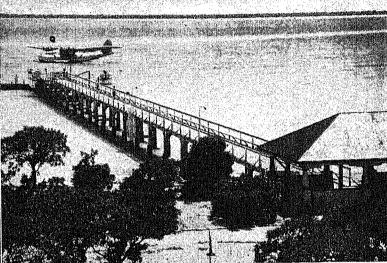


chemical foods have been added. Since roots need air, the water is aerated by a simple air pump.

Under these conditions of ceaseless feasting, plants grow at a rate that is amazing to the dirt-gardener. Dr. Gericke raised 1,226 pounds of tomatoes on 1/100 of an acre; from similar areas came 250 pounds of potatoes, and 100 stalks of celery. From 25 square feet of water

came 100 cantelopes; where the same soil area would have grown but five. The vegetables he grew contained double the amount of minerals valuable in human foods. The juice from his tomatoes was redder than usual.

Sand culture has been recommended particularly by Dr. John W. Shive of the New Jersey Experiment Station. Builders' sand is placed in shallow trays or pots, and the chemical solution drips continuously from tubes upon the sand, or rises through wicks. The sand distributes the plant food evenly. Dr. Shive has brought slowly growing plants into more rapid bloom and fruit, and his methods are employed in many florists' greenhouses.





At the top, right, is a view of the Clipper Ship harbor at Wake Island in the middle of the Pacific Ocean. Before war swept over the sandy island, all the fresh vegetables were grown by chemi-culture. At the left, Dr. Gericke stands beneath some tobacco plants growing from one of his tanks. They reached this gigantic height in four months. Below, we see a yield of 410 pounds of potatoes from a single tank, 6 feet wide and 24 feet long. The yield is at the rate of more than 2,000 bushels to the acre.

ing a tub or bucket carries out this irrigation for a small tank, pumps are used for large tanks. The same solution is used over and over again.

Chemicals for Chemiculture

For each of these three schemes of chemical plant feeding the same chemicals are used. There are many different mixtures, or formulas, for experience has shown wide differences in plant requirements. In general, however, these are the miner-

alsused and their quantities for small-scale hydroponics:

For chief elements: In one gallon of hydrant water dissolve (a) ½ teaspoonful (tsp.) primary potassium phosphate, KH₂PO₄, to supply potassium and phosphorus; (b) 1½ tsp. epsom salts, MgSO₄, to supply magnesium and sulphur; (c) 2 tsp. calcium nitrate, Ca (NO₃)₂, to supply calcium and nitrogen.

For trace elements: In one quart of water dissolve (a) ½ tsp. (1.5 gm.) boric acid, H₃BO₃; (b) ½ tsp. (1 gm.) manganese sulphate, MnSO₄; (c) ½₀ tsp. (0.5 gm.) copper sulphate, CuSO₄; (d) ½₀ tsp. (0.5 gm.) zinc sulphate, ZnSO₄. In a separate quart of water dissolve 1 tsp. (5 gm.) ammonium iron citrate, which

keeps well only by itself. When a gallon of the chief elements is ready for use, add 3 teaspoonfuls of the solution of trace elements, and one of the iron.

This mixture provides 11 chemical elements that plants must have to grow. About ten other elements are needed in such small quantities that hydrant water may be depended upon to supply them.

Advantages of Soilless Culture

All crops that require much space in fields may be grown economically in this way. Tomatoes have given the most surprising yields, but nearly all juicy vegetables thrive well. Crops that are naturally crowded, like grains and grasses, probably give as high a yield in well fertilized soil as with tank culture.

Out-of-season crops are now grown by hydroponic methods. Tomatoes have been raised in midwinter on Cape Cod, and sold at fancy prices in near-by Boston. Flowers that should bloom by Easter, or Christmas, are forced or retarded by changing the amount of their food, and adjusting the hours of their light.

Hydroponics offers an unusually interesting hobby for homes or schools. It keeps plants free from soilborne diseases. But they must, of course, be protected from insects and from gas fumes. A very small quantity of the ethylene (C₂H₄) present in household gas will make plants wither and die. A number of firms supply the dry chemicals already mixed, and even the trays may be purchased ready made.

MAN-MADE PLASTICS and Their COUNTLESS USES

PLASTICS. The family of plastics is an old and useful one. Its oldest member is clay, which has been molded by man into useful products throughout his entire history. Gums and waxes have long served him in the same way, and centuries ago man learned to make and shape many kinds of glass. It has remained, however, for a younger generation of the plastics family to excite the manufacturing and purchasing world. These are the new synthetic plastics which chemists have but recently learned how to make.

What is a plastic? The name may be applied to any substance that can be readily shaped or molded. Many metals, like copper, lead, iron, have plastic properties, but in common usage these are not called plastics. Ordinarily the name is given only to non-metallic

substances. And when chemists, manufacturers, and merchants speak and write of "plastics" today, they usually mean synthetic plastics, just as the word "car" usually means an automobile.

The word synthetic means "put together" in Greek, and the astonishing things that men are putting together to create new plastics are discussed later in this article. Already synthetic plastics are doing work far beyond the range of natural plastics. They are taking over services long performed by wood, metal, slate, ivory, glass, rubber, leather, silk, and wool.

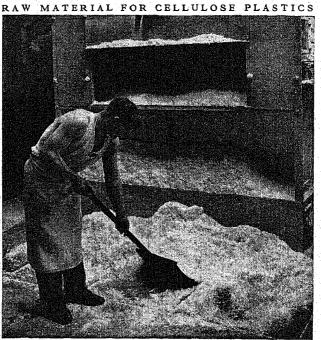
The first synthetic plastics were invented

because elephants were becoming scarce. Phelan and Collender, of New York, manufacturers of ivory billiard balls, offered a prize of \$10,000 to anyone who would invent an "artificial ivory." Two young printers, John Wesley Hyatt and his brother Isaiah of Newark, N. J., experimented with guncotton and camphor and were able to patent celluloid in June 1869.

The second man-made plastic was prepared in 1890 by a patient German professor, Dr. Adolph Spitteler of Hamburg, who was trying to make a white board for the schoolroom walls to replace the somber blackboard. He mixed sour milk with a pungent disinfectant, formaldehyde, and discovered that the curds of casein from the milk hardened to a shiny sheet. Although we still have the old-fashioned blackboards, hundreds of other

objects are now turned out of casein plastics made from the same material that gives us cottage cheese.

The third man-made plastic, and one that led into a great new field of research, was bakelite, the creation of Dr. Leo H. Backeland, chemist, of Yonkers, N. Y. For many years he had been trying to make an artificial resin to take the place of the natural resins (rosin. copal, shellac) used in varnishes. He mixed phenol (carbolic acid) from coal tar and formaldehyde and obtained a substance whichagainst all old rulesbecame hard when heated, and could never be remelted. Here was something of almost



The cellulose from wood or cotton has been ground up, purified, and passed through this drier in preparation for the solvents that will turn it into a plastic mass.

unlimited usefulness. It was tough. Acids and lyes did not eat it. Electricity could not pass through it. It was neither warped by dampness nor shrunken by age. Yet it was easily shaped and cut.

Dr. Baekeland told the world about his discovery in 1909. Advertised as "the material of a thousand uses,"

bakelite—as varnish, cement, solid, and in other forms—went to work. It came as a timely gift to the new industries that were manufacturing automobiles, airplanes, radios, electric fixtures, and the like, in which many small parts of queer but precise shapes were needed.

The success of bakelite set chemists all over the world exploring for other synthetic plastics. Some of the research workers developed substances that were related to the ones already discovered. Other

workers penetrated into entirely new fields. A broad outline of the results of this chemical research follows.

Relatives of Celluloid

We saw that the Hyatt brothers made their first celluloid from guncotton and camphor. Guncotton is a form of cellulose nitrate made by treating cotton or other cellulose fibers with a heavy dose of nitric and sulphuric acids. Lighter treatment yields the kind of cellulose nitrates often called pyroxylins. These are now used in making the several varieties of celluloid (see Celluloid; Cellulose; Pyroxylin Products).

Cellulose nitrates catch fire easily and burn with almost explosive violence. Early in the history of plastic research, chemists hunted for ways to make less inflammable materials from cellulose. Two principal kinds have been found and widely developed.

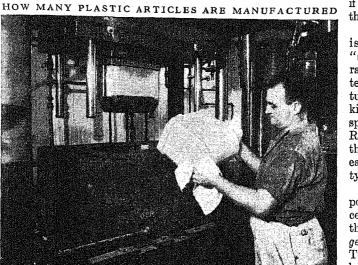
By treating cellulose with acetic acid and acetic anhydride, cellulose acetate is obtained. Its molding qualities are not quite so good as those of the nitrated cellulose; it does not stand hot water so well; and in thin strips, like those used in making motion picture film, it pulls apart more easily. But it equals its older relative in the unlimited range of transparent or opaque colors that may be added to it and is superior to it in its resistance to discoloration. Like celluloid, it is prepared in the form of sheets, rods, and tubes, which are used in fabricating thousands of different articles. But cellulose acetate is marketed also in granulated form for "injection mold-

ing." In this convenient process the granules are heated in a cylinder until they become soft enough to flow under pressure. The plastic mass is then forced into a water-cooled mold of the required shape, where it hardens in a few seconds. Because of the danger of fire or explosion, cellulose nitrate plastics are rarely

if ever molded in this manner.

Cellulose acetate is used to make "safety film" for X-ray work and amateur motion pictures, and certain kinds of rayon are spun from it (see Rayon). It formed the inner layer in earlier types of safety glass (see Glass).

The second important relative of celluloid that avoids the fire hazard is regenerated cellulose. To make it, cellulose fibers are treated with sodium hydroxide (pure lye) and carbon disulphide. This produces



The workman has just removed the case for a radio from the molding press. It was shaped when the plunger was forced down into the mold, below, compressing the soft plastic. Plunger and mold are heated sufficiently to set the plastic as soon as it is shaped. Both phenolic and urea plastics can be fabricated in this way.

a substance called cellulose xanthate or viscose. When threads or sheets of viscose pass into a bath of sulphuric acid and sodium sulphate, the intermediate chemicals are removed and pure cellulose remains. Strictly speaking, it is the viscose which is the plastic in this process, for the regenerated cellulose can no longer be melted or molded. Cellophane and one type of rayon are common examples of regenerated cellulose (see Rayon).

Some other cellulose plastics, not so widely used, are named in the list at the end of this article.

The Protein Group of Plastics

Casein, from which Dr. Spitteler made a plastic for his white blackboards, is one of the great group of substances called proteins. These are manufactured in the living bodies of plants and animals (see Proteins). Many of them coagulate or solidify when heated or when treated with suitable chemicals. The commonest example is the hardening of the white of an egg when it is boiled.

Casein for plastic making is obtained from skimmed milk, usually by adding to the milk an enzyme called rennet. The coagulated casein is collected, dried, and ground to a powder. A dye of the desired color is added, and a plasticizer such as glycerin. (In industrial chemistry any substance that is used primarily to make the raw material of a plastic soft, pliable, and cohesive during the manufacturing process is called a plasticizer.)

The casein mixture is now moistened and put into a heated cylinder press. From this it is squeezed out through openings that shape it into sheets, rods, or tubes. Or it may be injected into molds of the desired shape. The articles so produced must now be hardened by soaking for weeks in a watery solution of formaldehyde. Then they are dried slowly to prevent warping. The chemical changes that take place when casein and formaldehyde unite are complex and not perfectly understood.

Casein plastic is easily machined and polished, and large amounts are used in making buttons, ornamental buckles, beads, and small novelties. Because it tends to absorb moisture and to warp, it is unsuitable for

outdoor use or for precise fittings. To overcome this disadvantage, other chemicals such as phenol or urea are sometimes used with the formaldehyde in the hardening process.

Vegetable proteins also can be made into plastics by treatment with formaldehyde. The Ford Motor Company makes many fittings for its cars out of a plastic derived in this way from the protein extracted from soybean meal. Others have experimented with the protein from corn called zeein.

Phenolic Resin Plastics

When bakelite was first made, not even its inventor knew why this compound of phenol and formaldehyde hardened under heat. Later he and other chemists found out more about it. The molecules first

produced by the union of the two chemicals begin to undergo a change when the temperature reaches about 250° F. The change is controlled by the use of some catalyst-a sort of chemical "go-between" which loosens up the bonds within each molecule and so enables it to unite readily with its neighbors. The catalyst now commonly used has a complicated name, hexamethylene-tetramine; but its action is simple. It helps the phenol-formaldehyde molecules to join together into long chains. When this takes place, chemists say that a substance polymerizes; the word in Greek means to "become a thing of many parts." As the chains of molecules are formed, they seem to interlock and so create a firm hard mass, much as wool fibers do when they mat together to make felt.

Many variations of bakelite are now made commercially. In some cresol is used instead of phenol; in others furfural replaces the formaldehyde. But all are classed as phenolic resin plastics.

Three ways have been developed for fabricating these resins into useful forms-molding, casting, and laminating. For molding, the raw resin is dried and

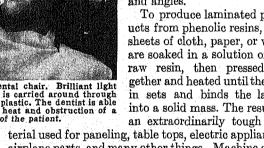
ground into a powder with a filler such as wood flour. graphite, or powdered asbestos. This mixture is put into steel molds of the desired shape, pressure is applied up to four or five tons to the square inch. and the temperature is raised to a point between 250° and 350° F. Hardening and setting takes place immediately. Parts of automobiles, radios, telephones, cameras, as well as of numerous household appliances are made in this way. Because molded phenolic plastics are naturally dark, the possible color variations obtainable by adding dyes or pigments are all on the dark side.

Cast phenolic plastics are made from the raw resin in its original syrupy state without fillers. The resin

is poured into lead molds and hardened by slow baking. It can be produced in a wide variety of colors—transparent white, clear amber, blues, reds, and greens, imitation ivory, and imitation marble. From it are made buttons, costume jewelry, toilet articles, clock cases, and countless novelties. It can be machined, threaded, engraved, or carved, and when placed in nearly boiling water can be bent to moderate curves and angles.

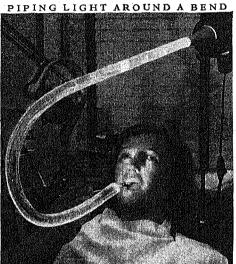
To produce laminated products from phenolic resins, thin sheets of cloth, paper, or wood are soaked in a solution of the raw resin, then pressed together and heated until the resin sets and binds the lavers into a solid mass. The result is an extraordinarily tough ma-

terial used for paneling, table tops, electric appliances, airplane parts, and many other things. Machine gears cut from it run silently and outwear steel. (See also Plywood: Veneer.)



The Newer Synthetic Plastics

One of the earliest fruits of the research stimulated by the success of bakelite was the discovery that urea treated with formaldehyde produces valuable resin plastics. The first commercially successful compounds of this type were brought out in 1928. Urea resins are of the same heat-curing type as phenolic resins and are fabricated in much the same way. The raw resins are colorless and thus are readily converted into transparent and translucent molded products of virtually any hue and shade. They have the advantage over the phenolic resins of being tasteless and odorless, and so they can be made into tableware and into containers for cosmetics. Because light and moderate heat do not discolor them they are coming to be widely used in the manufacture of lamps and lighting fixtures. The beetle brand was the first urea plastic widely marketed in the United States with the result that



Here is a patient in a dental chair. Brilliant light from the lamp behind her is carried around through the curved rod of acrylate plastic. The dentist is able to see clearly without the heat and obstruction of a lamp in front of the patient.

"beetleware" has become a popular term for all articles of this type.

Urea exists in nature only in animal secretions. It was, however, the very first of all organic compounds to be synthesized from its elements. Friedrich Wöhler, a German chemist, accomplished this history-making feat in 1828, exactly 100 years before the first

urea plastic appeared. Today virtually all the urea of commerce is made from ammonia and carbon dioxide.

Another group of synthetic plastics is derived from acetylene. Treated with hydrochloric acid, acetylene yields a compound called vinyl chloride; with acetic acid it produces vinyl acetate. Either of these or a mixture of both may be polymerized with the aid of heat, light, and a catalyst, resulting in the formation of a vinyl resin. Clear, tasteless, odorless, exceptionally tough, resisting fire, dampness, and the passage of electricity, the vinyl resin plastics compete chiefly with the cellulose plastics. They have largely replaced cellulose acetate in the manufacture of safety glass. From them also are made plates for false teeth and phonograph records.

Closely related to the vinyl resins is polystyrene or styrol resin. This plastic material is said to have the highest electric

insulating power of any synthetic resin.

In the same general group are the acrylate resins, prepared by complex reactions from oil gases. Their outstanding characteristic is their extraordinary transparency. They are clearer than most glass. Spectacle and camera lenses and the brilliant reflecting buttons on highway markers are made from them. They share with quartz and some of the other synthetic resins the property of conducting light around corners. Thus a beam shining on one end of a rod made of acrylate resin will travel inside the rod regardless of its curves, like water through a pipe, and will emerge with little loss of brightness at the other end.

Textiles Made from Plastics

An entirely new type of plastic appeared with the development of the polymeric amides of which nylon is

the most familiar. Their exact chemistry has not been made public, but they are described as protein-like in structure. The popular statement that nylon is made "from coal, air, and water" means that the raw materials for its manufacture are nitrogen taken from the air and certain chemicals derived from coal, and that the resulting material undergoes hydration.

The chief use of nylon is in the manufacture of stockings and other textile products. We have seen that two of the cellulose plastics are used to make rayon. From vinylresins comes vinyon, a silklike fiber that competes with nylon. Casein plastic is another that can be spun into threads useful in making cloth. The casein-base cloth, called lanital, has been widely used in Europe as a substitute for wool.

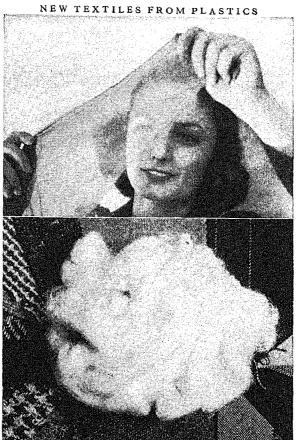


Virtually all plastics, either in their finished or semifinished stages, can be used as surface finishes. The article on Pyroxylin Products tells of the wide use of cellulose nitrate plastics in making lacquers, varnishes, and paints, as well as coated cloths like fabrikoid, which are tougher, more resistant to dirt or moisture, and often handsomer than

leather. About one-fourth of all the phenolic resins manufactured in the United States go into surface finishes of low cost but high quality. The vinyl resins are used to coat the inside of cans and paper containers in which food and beverages are sold.

A whole group of plastics—the alkyd resins—find their chief application in this field. They are made by combining glycerin with organic acids, the most commonly used acid being phthalic anhydride, a benzene derivative. Besides their value in the manufacture of paints, varnishes, and lacquers, alkyd plastics provide excellent baking enamels of the kind that coat household refrigerators and other metal furnishings.

For dissolving the various plastics both in the course of their original manufacture and in their application as paints and lacquers, a great array of special solvents have been developed commercially. Nearly all of them are organic liquids, such as acetic



The young woman in the top picture is examining a stocking made of nylon. Below is some artificial wool spun from casein plastic, together with samples of cloth woven from this man-made fiber.

acid, the various alcohols, ethers, and ketones, or combinations of these. Frequently the dissolved plastic makes an excellent adhesive or cement.

Classification of Synthetic Plastics

Synthetic plastics are broadly divided into two groups according to the effect of heat upon them. In the thermosetting group are those—like the casein, phenolic, and urea plastics—which are hardened by heat and aging during the course of manufacture and which cannot thereafter be remelted into a plastic condition. In the thermoplastic group are the cellulose nitrate and acetate plastics and most of the recently developed resins, which can be remelted and remolded indefinitely.

The following classification of synthetic plastics according to chemical origin is one widely used in industry. Trade names are printed in italics. Certain companies manufacture two or more different plastics under the same general trade name (as bakelite phenotics and bakelite urea plastics). In these cases the list gives the trade name under the group

with which it is most commonly associated.

Cellulose group

 a. Cellulose nitrate or pyroxylin plastics: celluloid, fiberloid, pyralin.

 b. Cellulose acetate plastics: acetate rayon (celanese), lumarith, plastacele, tenite.

c. Regenerated cellulose: viscose rayon, cellophane.
 d. Others, not so widely used, include aceto-butyrate cellulose, benzylcellulose, and ethylcellulose.

2. Protein group

a. Casein plastics: aladdinite, ameroid, galalith, lanital.

b. Soybean plastics.

3. Phenolic resins

- a. Phenol-formaldehyde type: bakelite, catalin, durez, fiberlon, formica, insurok, micarla, resinox, textolite.
 b. Phenol-furfural type: durite.
- Urea resins (urea-formaldehyde)
 Beetle, plaskon, unyte.

5. Vinyl resins

- -Butacite, butvar, koroseal, vinylite, vinyon.
- 6. Polystyrene Victron.

7. Acrylate resins

-Crystalite, lucite, plexiglass.

- Polymeric amides (Protein-like plastics)
 Nylon, exton.
- 9. Alkyd resins (hydroxy-carboxylic resins)
 Amberlac, dulux, glyptal, rezyl.

10. Miscellaneous group

 Indene-coumarone resins; lignin plastics (derived from wood); rubberlike plastics (see Rubber).

PLATA RIVER. The great estuary called the Plata River, or Rio de la Plata, formed by the junction of the Paraná and the Uruguay rivers, is the outlet for South America's chief commercial region. More than one million square miles, including Paraguay, most of Uruguay and Argentina, and parts of Bolivia and Brazil, are drained by the Plata River system. The Uruguay is about 1,000 miles long, and the Paraná is more than 2,000 miles long.

Though only 225 miles long, the Plata is 25 miles wide at its head and 138 miles wide at its mouth. In flood-time it discharges a volume of 2,000,000 feet a second, even more than the maximum of the Mississippi. The muddy current can be observed 100

miles out into the Atlantic.

The Plata brings the commerce of the world to the two great ports on its banks—Buenos Aires, capital of Argentina, and Montevideo, capital of Uruguay. Constant dredging is necessary to keep it navigable, because of the silt deposited by its muddy water. The early belief that silver abounded in this region is shown by the names "Plata" (Spanish for silver) and "Argentina" (from argentum, Latin for silver).

PLATINUM. Imagine a cube of silvery grayish-white platinum a foot each way. Not a great mass of metal, you might think. But try to pick it up, and you would quickly find your mistake, for platinum is nearly twice as heavy as lead. This cube would weigh more than half a ton, while a similar cube of coal would weigh only about 80 pounds.

In 1916 this cube would have been worth more than \$2,500,000 (at \$183 a troy ounce). Since then the price has been unstable, sometimes falling slightly below that of gold. Long considered to be useless, platinum was cheap for many years after it was named in the 18th century. Its name, a diminutive of the Spanish

"plata" (silver), means "little silver."

Since platinum resists oxidation, acids, and heat, it has taken its place among the most useful of metals. It resists any one of the common acids, but it can be dissolved in a mixture of nitric and hydrochloric acids. It withstands terrific heat; its melting point is about 3,190° F. For most purposes, it is alloyed with one of the other metals of the platinum group or with silver, gold, copper, nickel, or tin.

The chief use of platinum is in making jewelry. Because it is easily worked, the metal is used pure for fine chains and settings for diamonds. For hard jewelry it is alloyed with iridium. This durable alloy is used also to make national standards of weight and measure and for the writing tips of fountain pens. Dental fillings and points for pivot teeth are made of platinum to resist the powerful acids of saliva.

In laboratory and factory, platinum serves many purposes. It is used for crucibles, screens, and other equipment indispensable to the chemist. Platinumgold alloys are used in spinnerets to resist caustics

in the manufacture of rayon.

In its finely divided forms—platinum sponge, platinum black, and platinized asbestos—it has been one of the most useful of catalysts. These bring about chemical reactions without being themselves affected by any permanent change. For instance, hydrogen and oxygen are ordinarily indifferent to each other. But hold a bit of spongy platinum in a stream of escaping hydrogen, and the hydrogen will unite with the oxygen of the air, taking fire. So, too, in the contact process for making sulphuric acid, platinized asbestos is used as a catalyzing agent, though the cheaper vanadium is now replacing it.

Because platinum expands very little when heated, it is used in devices for measuring temperatures too hot for ordinary thermometers (see Pyrometer). It expands at about the same rate as glass, and it was formerly used for the lead-in wires of electric light bulbs. These wires are now made of cheaper metals, notably platinite, an alloy of iron and nickel.

Another useful property of platinum is its extreme

ductility. A single ounce could be drawn out into a wire, finer than a spider's thread, that would reach from New York to New Orleans. Platinum wire 30 times finer than human hair is used for fuses in delicate electric instruments.

Platinum occurs in small grains, flat scales, or nuggets, associated with gold, copper, or nickel, or with one or more of the five other platinum metals—iridium, osmium, palladium, rhodium, and ruthenium. In some years, Canada produces half or more of the world's platinum. Russia ranks next, followed by Colombia and the Union of South Africa. In the United States, where the output is small, Alaska, California, and Oregon are the chief producers.

The specific gravity of platinum is 21.9. It is one of the heaviest of metals, only a little lighter than osmium and iridium. On Mohs' scale, platinum has a hardness of 4.3, about the same as that of iron. Symbol, Pt. Atomic number, 78. Atomic weight, 195.23. Valence, 2 and 4.

PLATO (plā'tā) (427–347 B.C.). Of all the sages and philosophers of antiquity, Plato is the best known and the most widely quoted. Succeeding generations have clothed his name in a cloud of intellectual romance, and his many writings have been made the basis for an endless number of moral, religious, and political doctrines.

Born of aristocratic parents, Plato received the customary Athenian education in poetry, music, oratory, and gymnastics, and at about the age of 19 became a pupil and friend of that delightful teacher, the great Socrates. Plato remained with Socrates until the latter was put to death by the Athenians, in 399, assisting and defending the master at his trial (see Socrates). This association had the profoundest influence on the young man, and shaped all his later thoughts and his writings.

The next ten years Plato spent in travel, visiting Egypt and other countries on the Mediterranean. In Sicily he incurred the enmity of Dionysius, tyrant of Syracuse, who caused him to be sold as a slave. He was ransomed by one of his friends and returned to Athens, where he set up a school in the famous Academy, a pleasure ground about a mile outside the city. There beneath the lofty trees, Plato taught philosophy to the youth of Greece, until his death at the age of 80; and thus the word "academy" received the associations it has ever since borne. Plato's fame spread over all the civilized world, and brought him many pupils who later became famous. Chief among these was Aristotle, who was destined to surpass even his master in certain departments of philosophy (see Aristotle).

Plato left behind him a great number of works, mostly in the form of dialogues, in which Socrates appears as the leading character. It is chiefly through the mouth of his old teacher that Plato sets forth his doctrines, which are presented in the Socratic method of reasoning by question and answer. Written often in a high, almost poetic, vein, they are nevertheless examples of severe and subtle thinking. Benjamin Jowett (1817-1893), the distinguished English scholar whose translations of Plato have taken a high place in English literature, said that "the germs of all ideas, even of most Christian ones, are to be found in Plato." The best known of Plato's works are the 'Republic', in which he outlines the ideal government, the 'Symposium', in which a group of banquet guests discuss ideal Love and Beauty, the 'Timaeus', which deals with the nature of the physical universe, and the 'Apology', which is not in dialogue form, presenting a vivid portrayal and defense of Socrates.

LIVELY GAMES that are Played ALL OVER the WORLD

Play of Children Often Based On Ancient Practises of Religion, Mythology, and History — Some Attractive Amusements for All Ages

PLAY AND GAMES. Who invents children's games? Most of the old and popular games did not originate as mere games but have come down to us as survivals of tragic or comic or exciting events in history. They spread from country to country, with changes of name. On American playgrounds children play games from all over the world, which are often not recognized by the players as foreign games at all though they may have a history that goes back to the times of ancient Greece.

The playgrounds of Cleveland, Ohio, have made a special effort to spread the knowledge of origins of games, and of how games are played in foreign lands. They add to the fun by the use of national costumes. The accompanying pictures of Cleveland children in foreign games show a number of novelties, and also several of our familiar games under strange names.

Some games, such as "Fox and Geese," are great cosmopolitans, played in nearly every land. "Drop

the Handkerchief" is a favorite with Greek, Italian, Russian, and Japanese children.

Politics, religion, mythology, folk-tales, folk customs, common occupations, have all given rise to games which have spread from country to country. "Hide and Seek" has a most curious origin. It was once the custom among European peasants to go out in the spring and get birds, insects, and flowers to bring back to the village as proof of the approach of the happy season. This seeking for the simple heralds of spring is what the players of "Hide and Seek" unconsciously carry out in the game today. It has had many names. In old Greece it was called "Apodidraskein"; in France it is "Cache-cache" or "Cligne musette"; in Sweden "Kurragomma"; in Germany "Guckenbergen"; while in the Netherlands it is generally called "Verstoppertje," but is also known in the rural districts under the various old-fashioned names of "Borchspel," "Schuilwinkel," and "Schuilhoesken

A MODERN VARIATION OF AN OLD ITALIAN GAME



1. These children are playing "Hit the Pot," much as the game is described in the text, save that they are using a basketball instead of a pot. Any player failing to hit the ball with the object thrown, must sing, dance, or pay some other forfeit.

"CAT'S CRADLE"

duirkerken." In some countries the hidden players imitate the calls of birds, thus revealing the origin of the game.

"Drop the Handkerchief," also known as "Slipper

Slap" and "The Beater Goes Round," is derived from a folk-tale of the Northmen, which relates how Balder, becoming angry with his wife because she talked too freely at a feast of the gods, beat her and commanded her to be silent when men were talking. He further ordered that during the Juliestivities (Christmas) this game should be played as a reminder. The young people of Denmark played it when someone came late or made a mistake in a game. He then knelt, hid his face in the lap of Balder and was struck with a knotted handkerchief, to the accompaniment of a rhyme. A similar game was played in 11th century England and at various periods in Europe.

Circle games in which an object is passed around from hand to hand come, it is said, from an old Danish tale. Centuries ago a Danish nobleman, upon going off to war, left a pet bird with a peasant. The bird died and the peasant

peasant. The bird died and the peasant was severely punished. When the game is played in Denmark today, the players say "Lad ikke min Herre Fugl doee" (Let not my lord's bird die) as the circle of players pass from hand to hand a lighted paper or bit of wood. While it burns they say "Robin's alive!" The unlucky player in whose hands the fire goes out pays a forfeit.

"Hit the Pot," a blindfold game played in England,

Spain, Italy, and Germany, comes from a cruel pastime of a rougher age. In the old days a pot with a hole in the bottom was placed over a chicken whose head protruded. A blindfolded player struck at the poor creature. Today it is played with a pot on a stick, the blindfolded one having three chances to hit the pot.

"Musical Chairs," or "Going to Jerusalem," is known in Germany as "Mauer Blümchen" (Wallflower), and refers to the great loss of life in the Thirty Years' War, which left girls without partners. The game was devised to meet this lack, and was played as today, the leader crying at intervals "Mauer Blümchen!" to bring a change of position.

"London Bridge is Falling Down" originated far from London. The ancient Teutons imagined that the dead must pass over a high bridge on their way to the Great Beyond. Over the golden Gjallar bridge warriors went to Valhalla

(Heaven); others went over a trembling rotten bridge to the realm of Hel, goddess of death. The guard of each bridge led the people in his direction. When the game is played in Sweden, after the separation of the



2. This native of the Pelew Islands takes the string from his toes and twists it into novel designs. In Europe players take the string from each other's hands, changing the design.

"BRO, BRO, BREDA," A FIGHT BETWEEN GOOD AND EVIL



players into two groups, one guard reveals himself as the devil and hits his partners with the end of a rope. In France the dwellers in Heaven chase and tease the others. putting two fingers to the forehead to denote horns. In Slovenian countries. the two players forming the bridge lift each of the others on joined hands to

judge their weight and send them to one side or the other accordingly. In Denmark the game is called "Bro, Bro, Breda." The French call it "Falling Bridge" or "Heaven and Hell," and sing:

Trois fois passera, La dernière y restera. (Three times he will pass by, The third time he will remain.)

In all these countries the game is played in the same way: the two leaders form a bridge with joined and raised hands, and the other players form in a line and march under, singing a song, until the bridge drops on one player. He is given a tantalizing choice between two objects which determines his choice of sides. It ends with a tug of war between the sides.

Bro, bro, bre dat the clock has struck e - lev - ent We can see in his cas - tie grand the King so bold ly stand, As white as chalk, as black as coal; Hur - ry up, my sol - dier, your life is in great dan - ger; He who comes at the ver - y end, Shall his days in the ket - tie spend. First time we will let bim go, Sec-oud time he may pass at - so, When the third time he comes by, We'll throw him in the ket - tie.

3. This is a Danish version of "London Bridge is Falling Down." Singing the song shown, the players march under a bridge formed by two of the group. The last player is captured, and, after being offered a tantalizing choice between two objects, joins the army of good or of evil. The game ends in a tug of war between the two sides so formed.

"Prisoner's Base" and "Stealing Sticks" are said to date as far back as the first Olympic games, at which was played a game called "War is Declared." Players selected two camps, with a prison pen in each, and guards over each prison and each camp. Scouts would try to penetrate into the enemy's camp. If tagged, they must

stay in the enemy prison until tagged by one from their own camp, then make their way home without being tagged again.

"Defending the Pass," played in various ways in various countries, comes from the famous defense of the pass of Thermopylae by the 300 Spartan soldiers against the Persians. One way to play it is to draw up two lines of players facing each other. A player approaches from each end and attempts to pass between the lines to the other end. Each row of players tries to stop one of the invaders and drag him to their goal. If he succeeds in getting through the pass, he is given a ride in state by being passed the length of the line on the hands of the players in the facing lines. The loser must assist the winner in alighting at the end

SOME OF THE MOST POPULAR GAMES OF VARIOUS LANDS

China: Fox and Geese; Fruit Sale; Forcing the City Gates; Water Sprite; Chinese Wall; Letting Out the Doves; Wolf; Chinese Chickens; Buying a Lock.

Denmark: Baste the Bear; Robbers and Soldiers; Dog and Hare; Moving Day; Fish Game; Slipper Slap; Robin's Alive; Guard the Blind; Bro, Bro, Breda (London Bridge); King King Kloria.

England: London Bridge is Falling Down; Prisoner's Base; Chicken Market; The Pot Boils Over. France: King King Kloria; Falling Bridge (London

Bridge); Cache-cache (Hide and Seek).

Germany: Baste the Bear; Barley Break; Mauer Blumchen (Going to Jerusalem); King King Kloria; Crown the King; Dog Collar.

Greece: Defending the Pass; Brazen Fly (Blind Man's

Buff); Centipede; Duck on the Rock; Tree Toad: Oyster Shell; Pebble Chase; Drop the Handkerchief; Mount Ball; Olympic Game.

Italy: Morra; Chicken Market; Follow Chase; Hit the Pot.

Japan: Crab Race; Japanese Tag, or Statue; Kumi; Drop the Handkerchief.

Persia: Hide and Seek.

Scotland: Fire on the Mountain; Charlie Over the Water: Widower (Last Couple Out); How Many Miles to Babylon; Bologna Man; Stealing Sticks.

Spain: King King Kloria; Spanish Fly; Moon and Morning Stars.

Sweden: Last Couple Out; I See You; Stealing the Bone. Turkey: How Do You Like Your Neighbor?

of the line. Another arrangement is to seat the players in two rows. They ask questions of the one who is "It" as he passes down the center. His reply must contain not more than three words. If he succeeds in answering properly, he also gets a ride in state. The old military practise of "running the gauntlet" is said to have originated from the defense of Thermopylae,

"How Do You Like Your Neighbor?" is a game played in the Balkan countries and in Turkey. We know it was played in Constantinople as long ago as 1649. The players sit in a circle, and the leader in the center asks one of them "How do you like your neighbor?" The answer may be "Good" or "No good." If the latter, the player signals another on the opposite side of the circle to change seats with him, and the leader tries to get one of the seats. The player left without a seat becomes leader.

"Kumi," an old game of Japan, is most interesting and may have been the origin of a number of card games played by children today. Four groups take their places at a square table; each group receives 25 cards, which are placed face up on the table. On each card is written the last line of a familiar poem or song. A leader recites the first line of one of the poems. If the players having the card with the last line find it first, they place it in the center of the table, and it is out of play. If any member of the other three groups sees it first in the opponents' cards, he gives two cards to the group slow to recognize its "last lines." As Japanese script is easy to read upside down, the players need not leave their seats to examine their opponents' cards. The losers get white or black rings painted on their foreheads.

Many other games come down to us from ancient times. We know from pictures that Egyptian children centuries before the Christian era played a sort of checkers, a dice game, a finger game similar to the Italian "Morra," and various ball games, including one like the Greek "Mount Ball."

Twenty-five Foreign Games and How to Play Them

1. Hit the Pot (picture on page 248). A basketball is used as a pot, and the players obtain "valuables" in the form of pebbles, sticks, small coins, and the like. They form a circle and toss their valuables at the pot in the center, trying to hit it. Those who miss must pay a forfeit, such as a stunt, song, or dance.

2. Cat's Cradle (picture on page 248). A game found in nearly every land is the childish pastime of playing cat's cradle with a loop of string. The original name in English was "cratch cradle," which in turn comes from the French word "crèche" for "cradle."

As one player slips the string from the other's hands to his own, he must make it form a new type of "cradle," the number of cradles being limited only by the ingenuity of the players. In some countries bare feet are also brought into play in addition to the hands.

3. Bro, Bro, Breda (picture on page 249). The game is a variant of "London Bridge is Falling Down." The two players forming the "bridge" are called "The Sun," symbolizing God, or the powers of good, and "The Moon," symbolizing the Devil, or the powers of evil. The players sing the song on page 249 as they march in single file under the bridge. At the last word of the song, the bridge drops on a player, who is given a choice by the two leaders. The other players on whom the bridge has not yet dropped withdraw while the leaders ask the newly caught player, "Which would you rather have, a rose or a violet?" or perhaps

DIAGRAM OF "BARLEY BREAK" COURT BARLEY BREAKERS TWO BARLEY FIELD **GUARDS** BARLEY BREAKERS

The lively German game of "Barley Break" is played on a court like this, roughly scratched on the ground.

they offer a choice between a pearl and a diamond, a silk dress or a gold ring. Considerable imagination may enter into the items selected. The player's decision between the two enticing objects determines on which side of the bridge he will line up. When all the players are caught, the game ends in a tug of war.

A GROUP OF AMUSING GAMES FULL OF ACTION





4. Barley Break. A court is scratched on the ground, as shown in the diagram on the opposite page. Two guards link arms and face in opposite directions. Two teams of barley breakers run into the central field and taunt the guards, who try to catch them and prevent them from "breaking down the barley," before they return to their own field. Any barley

breaker caught must remain standing in the central field until his partner is caught. Then they become guards. Guards can catch the players only in the central field. They cannot enter the two side fields.

5. Water Sprite. The game resembles "Pom Pom Pullaway." From 10 to 30 players form two lines facing each other, with a large space between representing a river. One player, the Water Sprite, stands in the river and beckons to a player on one bank to

cross. This player then signals a player on the opposite bank and they try to exchange places without being caught by the Water Sprite. Anyone caught becomes Water Sprite.

6. Olympic. The game is derived from the old Greek Olympic games. The players divide into two teams, each team stands in two facing lines, and a basketball is tossed back and forth between the lines of each team for three-minute periods. Any player who lets a ball touch the ground drops out and his





4. The old German game of "Barley Break," which originated in the harvest season. 5. The Chinese game of "Water Sprite," which closely resembles "Pom Pom Pullaway." 6. The Greek "Olympic" game. 7. The Scottish singing game of "How Many Miles to Babylon?"

error scores five points for the opposite team. Fifty points constitute a game.

7. How Many Miles to Babylon? The game originated in the toll charge paid when entering a city. The players form in two rows, ten feet apart, each couple taking hold of hands. As the rows run forward, one row sings the words "How many miles to Babylon?"

As they dance back, the other row replies, "Three score and ten." They repeat the movement for the next four lines. The song is:

How many miles to Babylon?

Three score and ten.
Will there be any candle-light?

—Yes, and back again.
Open your gates and let us through.

-Not without a beck and a boo.

Here's a beck and herê's a boo,

Here's a side and here's a sou,

Open your gates and let us through.

At the words "Here's a beck" the singers

curtsy, at "Here's a boo" they bow. With "Here's a side and here's a sou" they bow and bend the head first to the right, then to the left. Then the partners clasp hands and run forward, taking eight quick steps to the rhythm of the words. Each couple passes under the upraised hands of the opposite couple, then turns around with four running steps. The couple that made the "gates" with their upraised hands then turn around in four running steps and face the first row. The game then begins again.

LIFE IN THE OLD WORLD SUPPLIES GAMES FOR THE NEW



8. Widower. This game is played in the same way as "Last Couple Out." The players pair off and line up, one couple behind another. The catcher stands at the head of the line, with his back to the players. When he cries "Widower," the last couple at the rear run forward and try to join hands again in front of the line without being touched by the catcher, or "Widower." The player caught becomes catcher.

9. Guard the Blind. The Blind Man, "It," is

blindfolded in the center of a circle of players. His guard tries to keep the players from touching him. When he is touched he calls "Stop," and each player must stay in the position he was in at the moment of command. "It" tries to guess the identity of the player who touched him. If he succeeds, the identified player is "It," and if not, the guard becomes "It" and a new guard is chosen.

10. Mount Ball. The game is derived from the old Olympic games. Twelve or more players form a double circle, in pairs, one member of each couple standing in front of the other. Then the smaller of each pair climbs on the shoulders of the larger.





8. The Scottish game of "Widower," which Americans call "Last Couple Out," 9. The Danish game of "Guard the Blind." 10. The Greek "Mount Ball" was played in ancient Egypt. 11. The Italian game of "Follow Chase" is derived from races through Italian archways.

The mounted players toss a basketball back and forth. Any player who drops the ball changes places with the boy on whose shoulders he is sitting. This is not a team game, merely lively exercise and amusement.

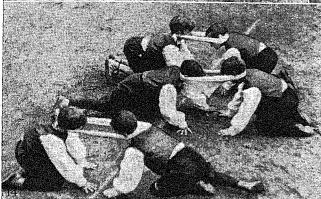
11. Follow Chase. The players stand in a circle and form arches by putting their arms across each other's shoulders. The chaser pursues a runner in and out of the circle through the arches, retracing the same path as the runner. This game

originated at fairs in Italy, where the young people chased each other in and out of the arches of arcaded galleries.

12. Letting Out the Doves. The players divide in groups of three, in which one is "Dove," one "Hawk," and one "Owner." The Owners make the gesture of tossing a dove in the air. The Doves then run a short distance and the Hawks are released. At a signal from the Owners, the Doves seek to return to the Owners uncaught by the Hawks, who, in pursuing, must retrace the route taken by the Doves. Any Dove caught becomes a Hawk, and the successful Hawk then becomes a Dove.

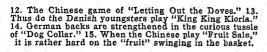
FOUR WAYS OF HAVING FUN AND GOOD EXERCISE





One stone of the wall at a time joins the Fairy until the captive is released, then they all dance around her.

14. Dog Collar. The players kneel in two lines, one line on each side of a straight line scratched on the ground, with the heads of each couple of opposing players inside a loop of strong cloth. At a signal, the contestants try to drag each other by the head across



13. King King Kloria. The game is derived from an old fairy tale of a king's daughter who fell in love with a knight, strong and brave, but poor and the son of a peasant. The king imprisoned his daughter in the tower of a castle surrounded by water. There she was to remain seven years, but a good fairy came to release her.

The game based on this tale is played in Spain, France, Germany, and Denmark. The players form a circle, each one representing one stone in the wall of the tower. The king's daughter sits in the center with her head covered. Outside the circle stands the Fairy, who sings:

King, King, Kloria, Who sits in the thoria (tower)?

The stones of the wall answer:

The captive daughter of a king, That is why we mourn and sing. The wall will never break, Her sweet life is at stake.

The Fairy sings:

Take one stone out And be busy about.



the line marked on the ground. The team dragging the most opponents across the line within one minute wins.

15. Fruit Sale. All but two of the players squat, locking their arms around their knees, and thus become "baskets of fruit." The "baskets" try to keep from smiling or unlocking their arms, while two players swing the baskets by the arms and do everything possible to make them laugh or loosen their grip. Any basket which "breaks" or smiles must pay whatever the basket-swingers may require as a forfeit.

16. Charlie Over the Water. The game originated during the exile of Charles II of England, "over the water" in France. Ten to thirty players form a circle, Charlie stands in the center, in front of a stick placed

CHILDREN MAKE GAMES OF SCOTTISH POLITICS AND JAPANESE ART



The Scottish game of "Charlie Over the Water" goes back to the days when exiled King Charles II was urged by the Scots to come back "over the water." 17. The Japanese game of "Japanese Statue" requires muscles to be quick and strong.

to represent a bridge. The players join hands and dance around, reciting in sing-song:

> Charlie over the water, Charlie over the sea, Charlie catch a blackbird, Can't catch me.

At the words "Can't catch me," Charlie jumps over the bridge and tries to tag the players before they stoop to the ground. If he succeeds, the tagged player becomes "Charlie." If he fails, he must jump back and forth across the stick as the rhyme is chanted.

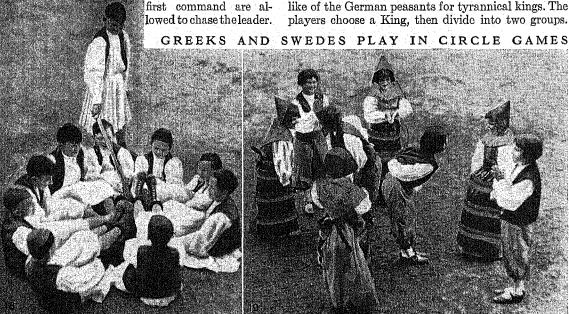
17. Japanese Statue, or Tag. The leader calls out a position, such as "Touch left foot," or "Put left elbow on right knee," then quickly shouts "Halt!" The players remain in the position they had reached at the command to halt. Only those who reached the

position required in the first command are alThe one who catches him becomes the new leader.

18. Centipede. From 10 to 20 players sit in a circle with their feet in a promiscuous pile in the center. The leader, with chalk or stick, touches a foot and asks one of the players whose foot it is. If the player guesses wrong, the leader chases him and strikes at him with a knotted handkerchief or folded paper. If the player guesses right, he takes the leader's place, the leader returning to the circle.

19. Schlag Tag. "It" passes around the circle of players, stopping before one. If "It" is a boy, he bows, if a girl, she curtsies. After the bow or curtsy, "It" runs, pursued by the player of his choice. "It" tries to return to the other's place in the circle before being caught. If touched, he continues to be "It," if not, the other player becomes "It."

20. Crown the King. The game grew out of the dis-



18. When the Greeks play "Centipede," unlucky is he who guesses the wrong set of feet. He is chased and slapped with a handker-chief. 19. In the Swedish "Schlag Tag," the same chasing and slapping ends a game beginning with polite curtsies.

FUN IN THREE NATIONS OF OCCIDENT AND ORIENT



One group forms a wall to guard the King by clasping each other around the waist and stooping over. Then the other group, one at a time, tries to reach the King by wriggling over the backs of the guards, who bounce and sway in order to shake off the aggressor. If he falls off, he loses. If he touches the King, he scores a point for his side. When all of the first group have had their chance to "crown" the King, the groups change sides, the guards becom-

ing aggressors and vice versa. Or, with fewer players, each boy may take a turn at crowning the King, and if he succeeds, he becomes King and the former King takes his place first in the line guarding the King.

21. Forcing the City Gates. Players lock hands in two lines facing each other, each line having a captain. One captain chooses a player to advance against the opposite side and try to force his way between two players. If he pushes their hands apart, he takes them over to his side. If not, he remains on their side. Captains alternate in sending out "gate breakers" and the side wins which finally gets all of the players away from the opposing side.



20. Thus do the Germans "Crown the King," with much turmoil among the revolutionary faction. 21. It takes strong arms to play this Chinese game of "Forcing the City Gates." 22. The Swedish game of "Stealing the Bone" begins with a lively song and ends with Doggie Doan chasing the thief.

22. Stealing the Bone. "It" squats in the center of a circle of players and covers his eyes. A small object, the "bone," lies behind him. The players dance around in a circle singing:

Doggie, Doggie Doan, You'd better guard the bone, For I will snatch and run away

And keep it for my own.

At the last word, the player nearest the "bone" snatches it and runs outside the circle, Doggie Doan in hot pursuit. If

the snatcher returns to his place in the circle before Doggie Doan, or "It," can catch him, the same player continues to be Doggie Doan. But if Doggie Doan succeeds in tagging the snatcher and recov-

ering his bone, the snatcher then becomes "It" and the game continues.

23. Crab Race. The players sit on the ground, then prop themselves up on hands and feet, with back to the ground. In this inconvenient position they race backward like crabs. A goal line is marked on the ground. The race may be run in relays if there are many players, or it may be an individual scramble, won by the girl or the boy who laughs least.

IT'S A GOOD TRICK, ESPECIALLY IN KIMONOS



The Japanese national costume, the kimono, is no help at all in running a "crab race." Neither is the laughter which shortens your wind as you try this ridiculous, upside-down, backward race on all fours.



Simple Games from Babyhood to School Days

ALTHOUGH the small baby is too young to play romping or complicated games, there are many simple games to play, which will develop both body

and intelligence. The simplest is probably "Peek-a-boo."

Peek-a-boo. The mother hides her face, says "Where is mother?" and then peeps out with the call of "Peek-aboo." "This little pig went to market," played on the toes, is another old favorite.

Most babies like to be danced on the knee or on a prancing foot. An amusing nonsense verse may accompany the



"This is the way the ladies ride!"

trotting, which is good exercise for the baby's body: This is the way the ladies ride;

Tri, tre, tre, tree, Tri, tre, tre, tree!

This is the way the ladies ride,

Tri, tre, tre, tre, tri-tre-tre-tree! (Move foot with quick jerky up-and-down movement)

This is the way the gentlemen ride;

Gallop-a-trot, gallop-a-trot! This is the way the gentlemen ride,

Gallop-a-gallop-a-trot!

(Move with slow long up-and-down movement)

This is the way the farmers ride: Hobbledy-hoy, Hobbledy-hoy!

This is the way the farmers ride; Hobbledy-hobbledy-hoy!

(With "hobbledy-hoy" move foot with wide sidewise movement almost throwing child off)

Here's a Ball. Finger plays, such as "Pat-a-cake," have always been popular. One of the favorites is "Here's a ball for Baby," played as shown below.

Here's a ball for Baby,

Big and soft and round! Here is Baby's hammer-O, how he can pound!

Here is Baby's music-Clapping, clapping so! Here are Baby's soldiers, Standing in a row!

Here is Baby's trumpet, Toot-too-toot! too-too! Here's the way that Baby Plays at "Peek-a-boo!"

Here's the big umbrella Keeps the Baby dry! Here's the Baby's cradle, Rock-a-baby-by!

Dance, Thumbkin, Dance. Whenever the word "Thumbkin" occurs in this game, the thumbs should be kept in rapid motion. At the word "merrymen," all the fingers



"Dance, Thumbkin, Dance."

are in fluttering movement; and so with "Foreman," the first finger; "Longman," the second finger; "Ringman," the third finger; and "Littleman," the fourth finger.

Dance, Thumbkin, dance,

Dance, ye merrymen, everyone.

For Thumbkin, he can dance alone,

Thumbkin, he can dance alone. Dance, Foreman, dance,

Dance, ye merrymen, everyone. But Foreman, he can dance alone,

Foreman, he can dance alone.

Dance, Longman, dance,

Dance, ye merrymen, everyone.

For Longman, he can dance alone, Longman, he can dance alone.

Dance, Ringman, dance,

Dance, ye merrymen, dance.

But Ringman cannot dance alone,

Ringman, he cannot dance alone.

Dance, Littleman, dance, Dance, ye merrymen, dance.

But Littleman, he can dance alone,

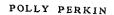
Littleman, he can dance alone.

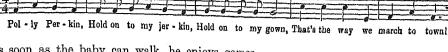
Simon Says "Thumbs Up." The leader calls out "Simon says 'thumbs up'," "Simon says 'thumbs down'," or "Simon says 'wiggle waggle'." The other players must do what Simon says, not what he does. The leader tries to confuse them by using the wrong action with his thumbs.

"HERE'S A BALL FOR BABY," FAVORITE OF THE VERY YOUNG



A small baby, even before he can talk, enjoys hearing his mother recite "Here's a ball for Baby," with the gestures as shown. The first picture represents the ball, 2 the hammer, 3 the music, 4 the soldiers, 5 the trumpet, 6 peek-a-boo, 7 the umbrella, and 8 the cradie. The verses in full are given in the text above.





As soon as the baby can walk, he enjoys games which involve marching or running around while singing a lively tune, such as "Polly Perkin." A number of other games and amusements for small children are described in the following suggestions.

Polly Perkin. The children form in line, grasp the dress or coat of the child ahead, and march about, perhaps through several rooms, singing the song above.

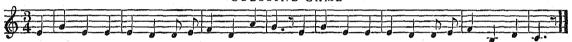
Guessing Game. The players form a circle, with one child, blindfolded, in the center. One child in the ring goes quietly out of sight; then the blindfold is removed from the child in the center. The children sing the song given below, while the center child tries to guess who left the ring. If he fails, he has a second trial while a different player leaves the ring. After that, another player is chosen to be blindfolded.

Little Sally Waters. Another singing game of which a party of little tots never tire is "Little Sally Waters." They eatch hands and form in a circle around "Sally"

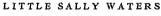


"Polly Perkin, hold on to my jerkin."

GUESSING GAME



Now tell, lit - tle play-mates, who is gone from the ring, And if you guess right-ly, we will clap as we sing,





who sits in the center of the circle; as they sing they slowly circle around "Sally." As the last word is sung they all stop. "Sally" rises and makes her selection. The one selected becomes "Sally" and the song and game starts over again.

Human Ten Pins. A group of 8 or 12 children stand in a row like bowling pins. Ten or fifteen feet away a line is drawn on which the "bowler" stands. He rolls a soccer ball towards the human ten pins, and the pin which is struck falls to the ground. If in falling the pin strikes another pin, that one also falls over. The dead pins then leave the group and the bowler has a second turn. The last pin standing takes the place of the bowler in the next game. If more than one pin

is left after two throws, the bowler may choose who is to be the next bowler. In scoring, each pin knocked down counts one point.

Quack, Quack. This game requires 9 or 10 children and may be played by many more. The child who is to be "It" is blindfolded and stands in the middle of a ring made by the others. He holds a cane. The children in the ring move quietly around. After a while, the blindfolded child raps on the floor with his cane, and the children stop moving. The blindfolded one then puts his cane on some child in the ring. The child touched by the cane must say "Quack, quack" in a disguised voice. If the blindfolded child guesses whom he has touched, then that child becomes "It."



CHOOSING Play Materials to FIT the CHILD'S NEEDS

PLAY MATERIALS. It is important to select play materials that are adapted to a child's age and development. If playthings are either too childish, or too difficult to handle, the child will not get the same value out of them that he would if they came at the right time. Small children need large toys. They do not have the muscular control to handle small objects well, and they need the exercise that comes from handling large objects.

Good playthings stimulate children to activity and lead to further development. Large blocks of assorted shapes and sizes have endless possibilities, because as the child grows older he can build more and more complicated structures. Balls build skills in running and throwing. Tools train in habits of creative activity, resourcefulness, and independence.

Most of the mechanical toys are to be avoided. Their possibilities are soon exhausted. Then they are thrown aside or destroyed, and the child is encouraged in habits of impatience, carelessness, and destructiveness.

All play materials should be simple, sturdy, and made to stand hard usage. A spade that won't dig without bending, or a set of paints that won't paint, irritates and discourages the child.

Many of the best play materials are simply common household objects and discarded materials. An attic or a basement can be made a children's paradise if the discarded articles usually thrown away are stored in boxes or trunks. Furniture can be made from packing cases and scrap lumber. A kitchen table with its legs cut off has many uses. If a child helps make and paint such articles, he learns many useful lessons and prizes them all the more.

Play materials may be roughly classified as follows: Large-muscle activity is provoked by balls, wagons, and skates. Crayons, beads, scissors, blocks, and tools stimulate manipulative and creative activity. Dolls, toy animals, trains, airplanes, and kitchen utensils develop imitative and imaginative play. Games promote socialized play. Children should have some playthings of each kind, but not too many.

Here is a graded list of suitable play materials for various ages. The divisions indicate the average ages at which children are usually ready for the materials suggested.

For the Baby

Strong celluloid and rubber rings, rough-surfaced balls and balloons, rattle with straight handle, bells, fast-colored or unpainted blocks, large strongly strung beads. Washable dolls and animals. Linen or oileloth picture-books. Boxes with covers, jars with removable lids. Clothespins, spools strung on tape, bunch of keys, clean paper to tear. Kitchenware: tin cup, pans with lids, spoons, soap-shaker, potato masher, and similar objects. (The baby puts everything into his mouth, so all playthings should be washable. They should be cleaned with soap and hot water daily or whenever they fall on the floor. There should be no paint to be sucked off, and celluloid and rubber articles should be heavy enough so that they cannot be bitten through.)

From One to Two

Small strong table and chair, rocking-chair horse, strong two-wheeled cart, wagon, doll-carriage, "kiddy-kar" (must have pedals). Rag doll, large Noah's ark with animals animals on wheels. Heavy wooden or iron train, toy automobiles, and similar floor toys; balls of various sizes. Bells, triangle, cymbals. Wagon with fast-colored blocks; nest of blocks; large hollow blocks; colored wooden cubes; abacus. Low firm boxes and planks to climb and walk on; empty boxes of various sizes. Outdoor apparatus: slide, see-saw, chair swing, sand pile. Measuring cup, large spoons, trowel, bucket and shovel, basket. Wide-mouthed bottles and jars, rolling pin, salt cellars, flour sifter, egg beater, tea kettle, and other kitchen utensils. Wall plugs and similar objects that can be fitted together or put into each other. Picture-books with simple stories.

From Two to Three

Wagons and carts of suitable size, wheelbarrow. Airplanes, trains, trucks, fire engine, toy telephone. Large doll, doll buggy, toy village. Large blocks and boards of various sizes and shapes; odd bits of lumber. Beads and buttons to string. Colored crayons, large pencils, drawing paper. Broom and dust pan, mop, brushes, toy stove, large unbreakable dishes. Plasticine, modeling clay and wax. Bean bags, prism, soap-bubble pipe. Peg board with large pegs (four or five inches long). Rake and shovel, snow shovel, watering can, large wagon, dump truck, tricycle, pedal-operated car. Waxed sliding board. Ladder made by nailing cross-pieces to sawhorse.

From Three to Five

Rag doll large enough to wear one-year-old child's clothes. Circus toys. Sets of construction blocks and logs, with many odd-shaped pieces. Concrete mixer, derrick, trucks, and other steel industrial toys. Hammer and nails and bits of soft lumber. Weaving loom, knitting ring, large needles and thread, buttons and bits of cloth. Blunt scissors and plenty of paper, paper dolls, magazines to cut up, scrapbook and paste. Water-color paints (large), simple stencils, rubber stamps, large blackboard and chalk, easel. Laundry and cooking sets of size large enough for actual use. Large dominoes, marbles, quoits, ring-toss games, tenpins, floor ball-games. Large simple picture-puzzles. Jungle gym, climbing rope, wooden and rope ladders. Scooter, coaster wagon, sled, roller skates, pedal automobile, jumping rope, football, toy boats. Piano box, large packing boxes (free from exposed nails and splinters).

From Five to Seven

Real carpenter tools, tool chest, work bench, foot rule, tape measure, bits of soft lumber. Better dolls with more elaborate clothing, doll house, doll furniture and dishes. Real typewriter, large hand stamp printing set, cash register, savings bank. Anagrams, around-the-world games, bird and animal games, and simple board games. Old maid, authors, and other simple card games. Large simply cut picture-puzzles. Electric train, erector set, sailboats. Magnifying glass, magnet, globe, maps. Scout outfit, knapsack, mess kit, compass. Indoor gym. Bicycle, ice skates, snow skates, toboggan, skis, hoop. Aquarium, bird houses, and other equipment for keeping pets.

From Seven to Ten

Airplane construction set, boat builder set, telephone set with batteries, other electrical equipment. Movie machine, camera. Complete doll housekeeping outfit, doll trunk, hat box, suitcase. Sewing outfit, bead loom, basket-making outfit, and other equipment for manual arts. Outfits for collecting stamps, butterflies, etc. Drawing set, microscope. Croquet set, golf clubs, football and baseball outfits, fishing outfit, indoor baseball, volley ball net, tennis racquet, tether ball. Ping-pong, indoor croquet, pool table. Checkers, halma, lotto, parchesi, crokinole, etc. Simple dissected maps (out on state or national boundary lines), picture-puzzles.

PLEIADES (plē'yā-dēz). The group of fixed stars known as the Pleiades were once, according to Greek mythology, the seven daughters of the Titan Atlas. According to one story, they killed themselves from grief at the fate of Atlas, their father, who was compelled to bear the weight of the heavens on his shoulders. According to another, they were companions of Artemis (Diana), and were rescued from the hunter Orion by the gods and set aloft in the sky. Only six of the stars are easily visible. The seventh, called "the lost Pleiad," was said to hide herself for shame because she had married a mortal. There are about 100 fainter stars in the group, which forms part of the constellation Taurus (the Bull).

PLOVER (pluv'ēr). Some of our greatest bird travelers belong to the plover family. Most of them cover great distances in the fall and winter migrations, but the golden plovers and the semipalmated plovers are the champions, for they breed in the Arctic and winter in South America from Brazil to Patagonia. (For map showing the routes of the golden plover, see Migration of Animals.) The Pacific golden plover migrates between Alaska and the Hawaiian Islands, China, and Australia. Black-bellied plovers breed all around the rim of the Arctic and migrate south to Australia, India, South Africa, and South America. Killdeers winter from New Jersey, Indiana, and California to as far south as Venezuela and Peru. They breed in Canada.

These members of the shore-bird group are smaller than most of their relatives, ranging from 7 to 12 inches. Since their short bills are not well adapted to digging in mud or soft sand, they often feed far inland. They usually lay four dark-spotted eggs in nests on the ground. In summer plumage, the blackbellied plover is blackish-brown below and black and white above; above the eye its head is white. The golden plover is black underneath with conspicuous yellow spots above. The semipalmated plover has a black ring around its neck, with crown and upper parts dark brownish-gray and lower parts white. The killdeer is white underneath and olive-brown above, with two black bands on the breast and two on the head. (For picture in colors, see Birds.) The killdeer is especially useful because it destroys many insect pests, including mosquitoes and fever ticks.

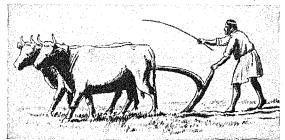
Among the Old World plovers are the golden plover, the gray plover, and the ringed plovers. This last group includes the ziczac, the remarkable African bird which picks parasites from the mouth of the crocodile and gives it the alarm at the approach of danger (see Crocodile).

Closely related to the plovers are the lapwings, or green plovers, which occasionally straggle across the Atlantic Ocean to North America.

Plovers, with snipe, sandpipers, avocets, stilts, and other shore birds, form the suborder Charadrii of the order Charadriiformes (see Snipe and Sandpipers). Scientific name of black-bellied plover, Squatarola squatarola; American golden plover, Pluvialis dominica dominica; semipalmated plover, Charadrius semipalmatus; killdeer, Oxyechus vociferus vociferus.

PLOW. When the plow developed from the crooked stick and crude wooden affair of primitive days to the modern well-planned steel tool, more land could be plowed and larger and better crops raised, for proper preparation of the soil is a basic condition of

FROM THE CROOKED STICK-



Primitive wooden plows like this can do little more than scratch the soil, but they are still used in India and other backward lands.

good agriculture. Until after the close of the American Revolution only the point or "share" of the plow was of iron. Then came several patents for cast iron plows; and in 1855 James Oliver of South Bend, Ind., revolutionized plow making with his invention of a process for making a chilled iron plow.

Plows are of many different kinds. There is the walking plow, which the plowman holds in position by gripping the curved handles. The sulky plow is a plow with wheels and a seat for the driver. The gang plow has two or more bottoms, and turns a number of furrows at once; large gangs of three to ten plows require a tractor. The sod plow for breaking

-TO THE TRACTOR-PULLED STEEL PLOW



This three-bottom, or three-blade, tractor-drawn plow digs a furrow seven inches deep and covers thirteen acres in a ten-hour working day. It is a popular size on 160- to 200-acre farms.

new land simply cuts and breaks up the sod. The subsoil plow is used for deep plowing. Plows are adapted to these various purposes by the shape of the plow bottom and the angle at which it is set on the frame. The parts of the plow bottom are the sharp-pointed share, which is directed into the ground and cuts the bottom of the furrow; the moldboard, which turns the furrow; and the landside or flat side, that takes the side pressure and aids in guiding the plow. A colter is often used to cut the sod ahead of the moldboard. The disk plow utilizes rotating steel disks set at an angle to the furrow, instead of a plowshare, to cut the soil. (See also Agriculture.)

PLUM. Wild and cultivated, coming from America, Asia, and Europe, ranging in size from a cherry to an egg, colored purple or dark blue, red, yellow, and green, plums are a common and productive fruit. The United States is well supplied with hardy varieties, adapted to all kinds of soil and practically every section of the country. When this continent was first settled by white men, many varieties of plums were found growing in different regions. These have been improved by cultivation and flourish in the orchards of their native regions. Among them are the comparatively useless beach plum of the Atlantic coast; the Canada, the Chickasaw, and the wild red, each in its section; and the wild goose, also a red plum, popular in the Central States, and so called because the parent tree grew from a seed taken from the crop of a wild goose.

In addition to the native varieties, cultivated plums from Europe have been introduced and flourish especially in the New England States and on the Pacific coast. Among these are the English damson, a small oval purple plum, and the small high-flavored green gages, as well as a number of egg plums. Many fine varieties of Japanese plums are adapted to growth in the Pacific coast region. This region is the leader in plum-growing, and the center of the important prune industry of this country; for the prune is a plum (all plums belong to the genus Prunus) and the most

important food variety. (See Prunes.)

The Bartlett plum is a "sport" variety developed by Burbank which has the flavor of a Bartlett pear. Plums have also been developed under cultivation with small stones and without any stones at all. Plums are grown from seed only for the sake of new varieties; old varieties are perpetuated by budding

and grafting.

PLUMBING. When you turn the water on or off in the kitchen sink or in the bathroom, you bring into play the water pipes; and when you pull up the stopper or otherwise allow the dirty water to drain out, you bring into play the drain pipes. These two systems of pipes form the essentials of a building's plumbing. The water pipes lead back from the faucets through floors and walls and out of the building to larger pipes or conduits under the streets, called water mains; and the drain pipes connect with underground conduits called sewers.

Modern plumbing fixtures are remarkable both for cleanliness and beauty. Painted iron or steel pipes, or the more expensive brass, copper, or nickel-plated pipes, convey hot and cold water into our shining porcelain or white enameled sinks, bowls, and tubs (see Enameling). Such fixtures are far more sanitary than the old-fashioned wood-inclosed plumbing—the grease-absorbing cast-iron sink, and the marble washbowl and sheathed-in bathtub, which gathered dirt and waste around their edges, joints, and corners.

The poisonous gases forming from the drainage matter in the sewers must be prevented from getting into the building through the drain pipes. This is accomplished generally by the "trap," a U-shaped or an S-shaped crook or elbow, with a clean-out on its under side. Water always stands in the bottom of the trap, so the gases cannot get beyond it. Traps should be equipped with vents or other devices to prevent this water from being exhausted by the forming of a vacuum in the waste pipe (see Siphon). Overflow outlets in bathtubs and other fixtures should never be connected to the sewer side of the trap (see Sewerage; Waterworks). Plumbing gets its name from the Latin word plumbum, meaning "lead," because pipes of this flexible metal have been found best adapted to such use.

PLU'TARCH (about 46-120 A.D.). Probably no historian of ancient times has been more widely read or has had a greater influence than this keen-witted historical essayist and biographer. Plutarch's 'Lives' has been called "the food of great souls" because of the wealth of wisdom it contains, and it formed the inexhaustible storehouse of fascinating stories from which Shakespeare drew the plots of several of his plays.

Plutarch was not a critical historian. He was interested primarily in character, and so he blended fact and legend into a tangle which only modern scholarship has been able to separate. But despite this defect, his biographies remain one of the foremost sources of information about classical antiquity. Young and old for centuries have delighted in reading them for their enthralling incidents and their masterly sketches of character, but the reader must remember that they are not all authentic history.

The 'Parallel Lives of Illustrious Greeks and Romans' are written in pairs, and they contrast the careers and qualities of such men as Demosthenes and Cicero, Alexander and Caesar, Pericles and Fabius. Besides these, Plutarch wrote about 60 ethical essays, known as the 'Opera Moralia', discussing such subjects as "The Education of Children," "How to Get Benefits out of Enemies," "Advice to the Married."

Plutarch was born at Chaeronea in Boeotia, a district of Greece; he was educated in philosophy at Athens, and spent several years at Rome, where he lectured on philosophy and enjoyed the friendship of men of learning. His last days were spent in his native city, where he was a magistrate and priest. He was much sought after for his delightful and learned conversation, and a school gathered about him to listen to his lectures.

PLUTO. In Greek and Roman mythology Pluto was the god of the lower world. He was first called Hades ("the unseen"), and was represented as pitiless and fear-inspiring. Later his character underwent a change and he became a beneficent god, bestowing blessings produced in the depths of the earth. His name then was changed to Pluto ("giver of wealth"). When Zeus, Poseidon, and Hades cast lots for the kingdoms of heaven, the sea, and the infernal regions, the last fell to Hades. Here he ruled with his wife Proserpine over the dead and over the other powers below (see Hades).

RED TO THE TO AN

PLYMOUTH, ENGLAND. The famous seaport from which the Pilgrim Fathers sailed in the Mayflower is the westernmost of England's Atlantic ports. It is at the head of Plymouth Sound in southwest Devonshire, a section of England noted for its gardens, hedges, beautiful green fields, and quiet country lanes. The city gets its name from the River Plym, at whose mouth it lies.

From the days of Elizabeth, Plymouth has been the starting point for many of the expeditions which made England the greatest of maritime nations. Sir Francis Drake left from this port on his world voyage of 1577–80. Hawkins, Raleigh, and Frobisher are other memorable names in the town's annals. From here in 1588 sailed the English fleet to meet the approaching

Armada of Spain. Almost two centuries later, in 1772 and 1776, Capt. James Cook sailed from Plymouth on his voyages of exploration.

The city today is a busy commercial port, naval station, and aviation base. It handles a considerable part of England's transatlantic trade. Its fisheries are important. In its Marine Biological Laboratory significant research has been done.

In the second World War Plymouth was a vitally strategic point because of its imports and because of its great docks and shipyards. Hence it was subjected to intense air raids by the Germans and suffered lamentable destruction of life and property. Even the commemoration stone marking the sailing of the May-flower did not escape damage. Population, 210,000.

"A BAND of EXILES on the Wild New England Shore"

THE FOUNDATION STONE OF NEW ENGLAND

PLYMOUTH, Mass. When the Mayflower dropped her anchor in the harbor of Plymouth, in December 1620, and the weary storm-tossed Pilgrims stepped upon that shore (see 'Mayflower'), they rejoiced that

their long hard voyage was over. But the worst of their trials and hardships was yet to come, and more than half of the little band died during that first year of indescribable sufferings.

Their place of settlement had previously been explored by Captain John Smith and had, strangely enough, been named Plymouth after the very port in England from which the Pilgrims had embarked. So here it was that the historic landing of the Pilgrims was first made, on Dec. 11, 1620 (or December 21, accord-

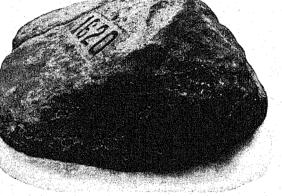
ing to the new style of reckoning—see Calendar). It was not until a week later that the rest of the party, including the women and children, set foot on shore.

The cruel New England winter was already upon them, and the whole country "was full of woods and thickets, and presented a wild and savage hue." At once they set about felling, sawing, and splitting timber for their storehouse and crude dwellings. They had no horses or oxen to haul the logs, and but a few axes and other simple tools. The labor was exhausting and they suffered intensely from exposure and the constant wetting in coming and going from the ship. After the *Mayflower* departed, food was scanty and consisted mostly of fish. A dreadful pestilence came upon them and wrought such havoc that at one time there were only about six or seven well persons to

care for the others. Among these was Miles Standish, who proved himself a tender nurse as well as a fearless soldier. The women suffered most, and of 16 mothers but four remained alive at the close of that terrible

winter. Of 25 fathers, only 12 were left. Governor Carver was among those who passed away, but under the wise leadership of William Bradford, the second governor, the colony survived.

Lest the Indians should learn how greatly their numbers were reduced, the bodies of those who died were buried at night, and in the spring corn was planted over the graves. Fortunately the settlers were able to win the friendship of some of the Indian leaders. Tisquantum, or Squanto, an Indian who had been



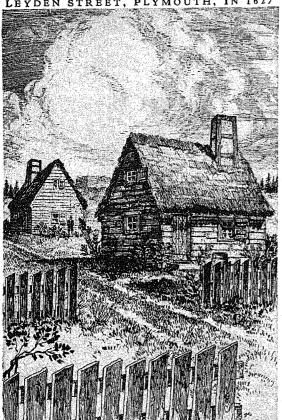
According to legend, the Pilgrims stepped upon this bowlder from their ship Mayflower, when they landed in the harbor of Plymouth. The rock is now protected by an elaborate canopy erected in 1920 to celebrate the 300th anniversary of the Pilgrims' landing.

captured by the crew of an English vessel to be sold as a slave in Spain, but who had escaped to England and there learned the English language, became their interpreter. Through him and Samoset, an Indian chief, a meeting was arranged with the powerful Massasoit, sachem of the Wampanoags, and a treaty of peace was signed. This was never broken on either side so long as any of the signers lived. Massasoit proved himself a true friend to the Pilgrims, and sent them news of a threatened attack by other Indian tribes. One day an Indian brave came bearing the skin of a rattlesnake filled with arrows, as a challenge to war from the chief of the Narragansetts. Governor Bradford returned the skin filled with bullets, and the Indians abandoned the attack.

The friendly Indians also taught them how to plant Indian corn, and next year's harvest banished famine



IN 1627 LEYDEN STREET, PLYMOUTH,



The Pilgrims soon replaced their first temporary shelters with neat frame houses, like those of their English homeland. The tradition that they built log houses is demolished in The Log tradition that they built log houses is demolished in 'The Log Cabin Myth' by H. R. Shurtleff, from which this illustration is reproduced (courtesy Harvard University Press).

and want from the settlement. In ten years the result of the brave venture of this little band of freedom seekers in the New World had proved not only a great

moral victory, but an economic success as well. Thus they paved the way for further colonization, and laid the foundation of the new nation.

Plymouth Today

The visitor to modern Plymouth will find many reminders of the past. On the waterfront is the hallowed Plymouth Rock on which the Pilgrims are said to have stepped as they came ashore. Although historians have discredited the tradition, popular sentiment clings to it. The stone has been placed under a granite portico of classical design. An iron fence protects it from souvenir chippers.

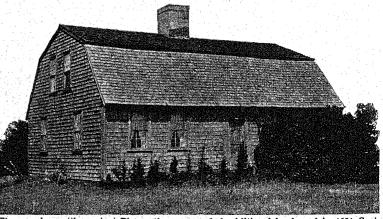
A statue of Massasoit crowns Cole's Hill, back of the Rock, where the dead were secretly buried that first hard winter. Along Leyden Street the Pilgrims built their first homes. These were probably wooden frame houses covered with clapboards, similar to those which have been reproduced at Salem, Mass. (see American Colonies, A-162). None of the original houses remain, but on near-by streets there are five houses which were built later in the same century. and several built in the 18th century.

Leyden Street runs from the waterfront up to Burial Hill, where the old fort was built in the summer of 1622. A visitor to Plymouth in 1638 described it as follows: "Upon the hill they have a large square house, with a flat roof, built of thick sawn planks stayed with oak beams, upon the top of which they have six cannon, which shoot iron balls of 4 and 5 pounds, and command the surrounding country. The lower part they use for their church . . ." A reproduction of the powder house stands on the hill today, and there are many graves of the Pilgrims and their descendants.

In Pilgrim Hall, erected by the Pilgrim Society in 1824, may be seen the patent of Plymouth Colony, granted by the Council for New England in 1621; the chairs of Elder Brewster and Governor Carver; the cradle of Peregrine White, first white child born in Massachusetts; the Bible of Governor Bradford, printed in 1592; and the sword of Miles Standish. In the Registry Building are the records of Plymouth Colony until it was united with Massachusetts Bay Colony in 1691, and the charter granted in 1630. The National Monument to the Forefathers, dedicated in 1889, stands in the northwestern part of the town.

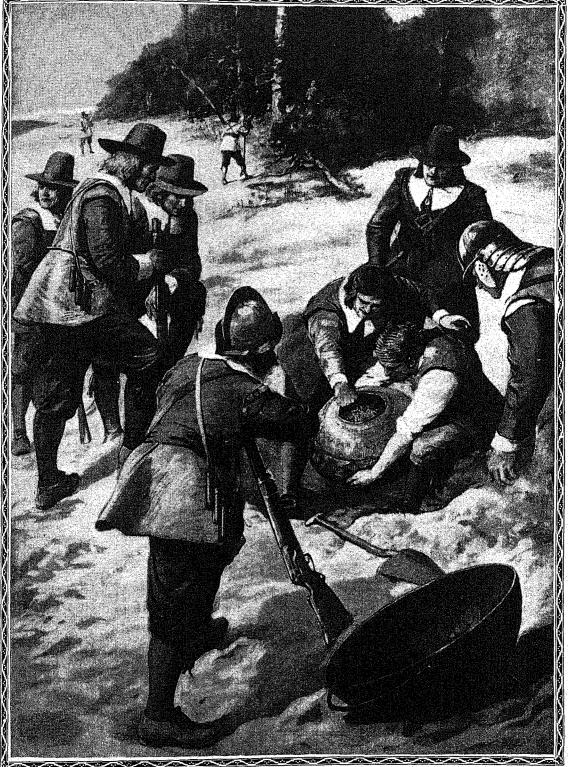
Ropemaking was among the earliest of Plymouth's industries, and the town still has one of the world's largest cordage works. Plymouth County produces more cranberries than any other region in the world. The herring fisheries are important, and there are clam and brook trout hatcheries. The tourist industry is a valuable resource. Population (1940 census), 13,100.

THE STANDISH HOUSE IN DUXBURY



The growing settlement at Plymouth soon needed additional land, and in 1631 Capt. Miles Standish and John Alden founded Duxbury, a few miles to the north. This two-story frame house was built in 1666 by Alexander Standish, son of the famous soldier-colonist. Some of its timbers are from the Captain's original dwelling, which had burned. Note the gambrel roof, which was used in many New England buildings.

THE PILGRIMS FIND BASKETS OF CORN



In the middle of their first winter, with food scarce in the little settlement and no prospect of help from England until spring, the men explored the neighborhood, and in some heaps of sand found baskets of corn, which the Indians had stored in this way for their winter needs. Corn was an unknown grain to the colonists, but they found it much to their liking, and in the spring some friendly indians gave them more corn for seed, and showed them how to plant it.

PLYWOOD. Layers of thinly sliced wood glued together form plywood. The grain of each layer runs at an angle to the grain of its neighbors. This crossgraining gives great strength, equalizes expansion

and contraction, and prevents splitting.

Though plywood dates back to 1500 B.C., not until modern methods of production were introduced did it take its place as an outstanding construction material. Previously the layers or plies were cut from the flat surface of a split log and no plies wider than the log itself could be produced. Today a smoothed log is revolved in a huge lathe against a long cutter blade. This shaves off from the circumference of the log a continuous sheet of wood, much as you unwind paper from a roll. Any desired thickness from 1/4 to 1/40 of an inch can be obtained. The sheets are then cut to size—usually 4 feet wide and up to 12 feet long and the required number are bonded together. Plywoods have been greatly improved also by fastening

the plies together with synthetic plastics instead of the older types of glues. Among the plastics used are the phenol formaldehyde and the urea resins (see Plastics). Some plastic-bonded plywoods withstand continuous soaking in water

without coming apart.

Even tougher are the plywoods permeated through and through with heat-setting plastics. The plies are impregnated with the plastic material, then pressed together and heated. They unite to form a material stronger per pound of weight than solid steel.

When curved surfaces are required, strips of impregnated layers are shaped around proposed forms and set by heat and pressure. Life boats so constructed out-perform steel boats. Airplane fuselages, wings, and control surfaces are often made in this way. Because of their lightness and the glasslike finish free from joints and rivets, plywood aircraft are said to require 25 per cent less power. They are also held to be safer, for plywood, unlike metals, does not break when subjected to repeated bending or continual vibration.

Many pre-fabricated houses are built almost wholly of plywood, with plasticbonded types for the exterior and ordinary plywood for interior work. Beautiful paneling, furniture, radio cabinets, and pianos are made of plywoods with veneers of fine figured hardwood for the outer surface. (See Veneer.)

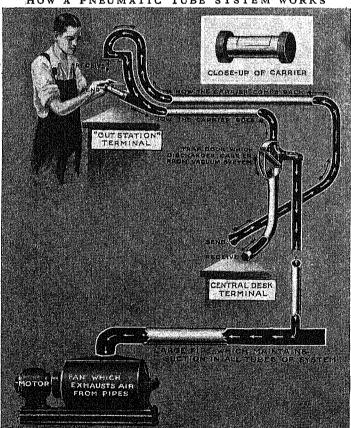
PNEUMATIC APPLIANCES. "As light as air" is a saying which expresses the everyday

opinion about the substance we breathe. But when this seemingly "weightless" substance is compressed, it exerts tremendous power. So also if it be exhausted from an enclosed space, the inrush of other air to fill the vacuum is powerful (see Vacuum). These two sorts of power have been applied to a great variety of useful tasks.

One of them can be seen in most large department stores. If you take a long brass tube and connect an air pump so that the air is continually being exhausted from it, the air will rush in violently when either end is opened. Suppose now you open one end and slip in a small brass cylinder, with felt around its ends to make it fit the tube. The pressure of air trying to get in the tube from behind will shoot the cylinder along the tube, and by placing the other end at any desired point, you can make the arrangement deliver the cylinder anywhere you want. A trap door at the other end lets the cylinder out and snaps shut before outside air can enter and reduce the vacuum,

In place of this method of using outside pressure against a vacuum, some systems use compressed air to

PNEUMATIC TUBE SYSTEM WORKS HOW



This picture shows how the carriers travel back and forth in the tubes of a big store. When the carrier is inserted at any point in the system, it speeds forward until it strikes a trap door, which opens outward. The door snaps open long enough to let out the carrier, but not long enough to let in much air. A suction fan is constantly exhausting the air from the pipes.

drive the carrier cylinder along. Each one of these systems is widely used to transmit messages in large banks, to send "copy" from department to department of newspaper offices, and even under city streets

COMPRESSED AIR WRECKS A BUILDING

from central news distributing agencies to the different newspapers in a city. Large tubes are also employed to carry mail and packages about large postoffices, and between postoffices and railway stations. In a

three-inch tube a loaded carrier will travel 1,000 yards a minute under a tenpound pressure, and the speed on other tubes varies according to the size of the tube, load, and pressure used.

If you blow across the surface of a dish of water, you know that the blast carries off a quantity of water in a fine spray. This fact is used in instruments commonly called "guns" to spray liquids. A blast of compressed air crosses the substance to be sprayed, and a nozzle directs

the spray. Paint and cement are often applied to surfaces in this way, and the "sand blast" is used to direct a stream of sand against the sides of buildings to scour off grime and dirt. Artists use a similar device called an "air brush" which sprays black or colored pigments on the drawing paper much more evenly and with finer gradations of tone than are possible with the strokes of an ordinary brush.

Compressed air can also be used to drive pistons in cylinders, just as steam is in the steam engine. The pneumatic hammer and pneumatic presses and drills are examples of this use of air. In hammers the compressed air is applied to each side of a piston in turn, and some types will deliver as many as 20,000 blows a minute. In pneumatic presses the air is applied to a plunger, while other devices employ

small motors geared to the working tool. Compressed air locomotives are often used in mines, ammunition factories, and other places where steam or electric locomotives would be dangerous or undesirable. Compressed air is also used as a cushion, the automobile tire being the most important example.

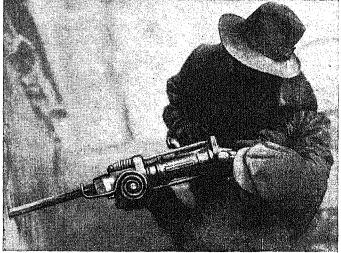
If compressed air be driven into a water-filled tunnel or an inverted cuplike chamber under water, the pressure of the air will keep the water out, and

did hotel in New York City. This useful is oftenest seen in the hands of workevements to lay new pipes.

water, the pressure of the air will keep the water out, and provide a space in which men can work. Compressed air is largely used in this way in driving foundations and tunnels through watery soil, under rivers, and in making foundations for structures like lighthouses

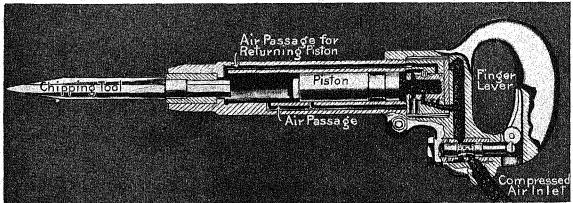
and bridges. (See Tunnels and Subways.)

Pneumatics is the name sometimes given to the branch of physics that treats of the mechanical properties of air and other gases, such as their behavior when set in motion and their elasticity and density. It includes also the practical application of these properties in the devices and machinery of the type described in this article. (See also Air.)



Here we see two men using the versatile air hammer, equipped with a drill, to tear down the solid brick walls of an old hotel in New York City. This useful tool saves many hours of hand labor. It is oftenest seen in the hands of workmen who are cutting through pavements to lay new pipes.

THESE HAMMERS AVERAGE 1,600 BLOWS A MINUTE



This cut-away view of the air hammer shown in the picture above, explains its operating mechanism. Slight pressure on the finger lever, on the right, lets compressed air into the chamber back of the piston. This forces the piston sharply against the chipping tool. In the meantime, the position of the valves in the rear is automatically changed so that air is forced through the upper passage to drive the piston back. Another valve in the main chamber, back of the piston, allows the air to escape. This operation is repeated so rapidly that the blows sound like shots from a machine gun.

PO RIVER. Rising high in the Cottian Alps in the extreme western border, Italy's largest river is a mountain torrent in the first stage of its 420-mile course to the sea, and falls more than 5,200 feet in only 21 miles. Fed by the "aged snows" of the Alps, and by tributary streams, it widens to 425 feet as it nears the busy city of Turin, and moves more slowly. At last, winding sluggishly across "fruitful Lombardy, the pleasant garden of great Italy," it at last finds its way around its huge delta into the Adriatic.

With fine sediment that the river carries from the Alps and from the Apennines, it increases the area of its delta about 175 acres every year, so that some towns once on the coast are now several miles inland. It also keeps raising its bed, which is in many places above the level of the surrounding country. The resulting floods (despite the many dikes that have been built from Cremona to the delta, some of them of unknown antiquity) often prove disastrous.

The volume of water discharged by the Po almost equals that of the Rhine. Because of its great volume and width it is a hard river to cross, and its commercial cities such as Piacenza and Turin are found where there are the easiest fords. This great river, teeming with salmon, shad, sturgeon, and other fish, as it flows through Piedmont, Lombardy, and the southern edge of Venetia, has a drainage basin covering most of northern Italy.

POE, EDGAR ALLAN (1809–1849). In the annals of literature there is no more dark and disastrous career than that of this American poet and story writer whose inherent faults of character and bad training combined to quench in early death a truly fine and

original genius.

From his mother, an English actress, and his father, a stage-struck youth of Baltimore, who left him an orphan in infancy, Poe inherited a highly nervous and emotional temperament, that needed the kindest and wisest oversight. Instead, the handsome precocious boy, alternately indulged and treated with severity, was brought up as the spoiled heir to the va., who adopted him. Then, after he had been taken from Virginia University and expelled from West Point Academy for his dissipated habits and insubordination, Mr. Allan disowned and disinherited him. At 25, with the expensive tastes of a gentleman and no training for a profession, Poe was obliged to live on the charity of his father's poor sister, a Mrs. Clemm of Baltimore. There he took local prizes for prose and verse, and discovered literary talents for which he found employment in Philadelphia and New York. A man of striking personal appearance, charming manners, and obvious gifts, Poe readily secured positions on the leading magazines of the day. But his weakness of will and occasional dissipations made him undependable and kept him in poverty. Yet in intervals of deadening hack work, Poe wrote short stories and verse, which, while small in amount, are among the most precious of American literary classics.

In poetry his genius was unique. He makes no appeal to the intellect but, as a result sometimes of his own morbid state of mind, expresses a melancholy sensuous emotion in verse, whose perfection of melody suggests fine musical compositions. His prose stories are different, but have an equal fascination. He gives form to horror and fear, or constructs and unravels mysteries with fidelity to scientific principles. Poe was more truly a world author than almost any other creative American writer; but so purely his own was his inspiration that he would have appeared a literary alien in any country. In the United States there is greater appreciation of his poetry than of his prose: while in France especially his short stories are classic models, on which famous writers have formed their style. A conscientious literary artist, he revised and perfected everything he wrote, and only by infinite painstaking secured his effects of spontaneity. The publication of 'The Raven' made him the literary lion of the day; but good was followed by ill fortune. He had married his cousin, Virginia Clemm, a beautiful girl and the "sainted maiden" of 'The Raven'. Two years after the appearance of this famous poem, his idolized young wife died, after a long decline and amid the tragic privations of poverty. In grief and remorse Poe made a heroic effort to conquer his weakness, but he died wretchedly in a Baltimore hospital.

Poe's chief works are: 'Tamerlane and Other Poems' (1827); 'Poems' (1831); 'Narrative of Arthur Gordon Pym' (1838); 'Tales of the Grotesque and Arabesque' (1840); 'The Raven and Other Poems' (1845); 'Tales' (1845).

POET LAUREATE. As the laurel tree, in ancient Greece, was considered sacred to the god Apollo, patron of poets, the custom arose of crowning poets who had won distinction with a wreath of laurel. Later the same practice was followed in Italy, where Petrarch and Tasso received this honor. In time the word "laureate," which meant originally "crowned with laurel," came to mean honored or eminent.

The title "poet laureate" is given in England to the poet attached to the royal household. From very early times it was the custom of the English kings to include poets or minstrels in their retinue. Instead of being crowned, however, they were granted pensions as a mark of royal favor. Such a pension, together with a pitcher of wine daily, was granted to Chaucer in the 14th century; and Spenser in the 16th century was honored in a similar manner. Ben Jonson (1617–1637) was probably the first to hold a regular office as court poet, and he was succeeded by Sir William Davenant in 1638. John Dryden, who held the office from 1670 to 1688, was, so far as is known, the first to receive the official title of Poet Laureate. The salary is only about £100.

Dryden's successors, and their terms of office, have been Thomas Shadwell (1688–1692); Nahum Tate (1692–1715); Nicholas Rowe (1715–1718); Laurence Eusden (1718–1730); Colley Cibber (1730–1757); William Whitehead (1757–1785); Thomas Warton (1785–1790); Henry James Pye (1790–1813); Southey (1813–1843); Wordsworth (1843–1850); Tennyson (1850–1892); Alfred Austin (1896–1913); Robert Bridges (1913–1930); John Masefield (1930–).

The MAGIC of POETRY and the POET'S ART

How the Music of Verse Is Made by Rhyme, Meter, and Pattern

POETRY. Poetry is one of the oldest of the arts and one of the most persistent. We do not know who the first person was who had the idea of telling a story or expressing a thought in rhythmic, chanting words with a strong and easily remembered beat. Perhaps he thudded a drum-log by some very early campfire and, as he thought of his day's hunting or the fearfulness of the night or his own bravery, began to fit words to the rough tune. He would chant and stamp and beat as he made those words. Where the words did not fill out the tune, he would give a shout or a cry. That must have been the earliest and most primitive form of poetry-rhythmic words, chanted aloud to a rough musical accompaniment or to no accompaniment at all but the stamp of the chanter's feet on the ground, the slap of his hands on his body to mark the pulse of the

He was saying something, but he was singing it as well; he was making his words a drum-beat or the rush of a storm, a prayer or a call to battle. If he had merely wanted to tell his friends that he was hungry or that he had seen a fine herd of deer in the forest, he would not have needed the drum or the cry or the chant. He would have said what he had to say in prose, as we do when we write an ordinary letter about ordinary things. But he wanted to do more than that. He wanted his friends to remember what he said and to think about it. He wanted to excite and stir them as he was excited and stirred. So he made a song, in words.

Then, if people liked the song, they would listen. A very famous song might be passed down and down through the generations by word of mouth, until there got to be something sacred about it. Till, at last, poems were written down—and Alexander the Great, as he strove to conquer the world, carried Homer's 'Iliad' about with him in a gold casket; and James Wolfe, the great British general, told his council, on the eve of victory, that he would rather have written Gray's 'Elegy' than capture Quebec. For that is the way that great men and great nations have felt about great poetry. They have thought of it not as a task or an ornament, but as an essential part of the greatness of life.

The Poet's Purpose

It is a long way from the chanting singer, in the red light of the campfire, to the printed book of verse in your library. But the road is a clear one, and the poet's intent the same. He is trying to tell you something—perhaps a story about gods or heroes, about lumberjacks or sailors or the people you meet every day—perhaps merely about his own feelings when he sees a cloud or a flower—perhaps about the mysterious things of life, the things like death and birth and the great empty places between the stars which make us feel small and wondering when we stand before them.

But he is trying to tell it to you rhythmically, in musical words that will stir your imagination and leave a magic pattern on your mind. Most people talk a great deal but say very little; the poet tries to talk very little but say a great deal. He wants to make you see what he has seen and feel what he has felt. To do so, he uses words not only for their meaning but for their ring and music—as a composer uses the sound of certain musical instruments, alone or in combination, when he wishes to make you think of the sea or the forest, of the trumpets of battle or the voices of lovers at night.

The Music in Primitive Poetry

We know what primitive poetry is like; we have very fine examples of it in the ceremonial chants of our own North American Indians. When the Indian singer chants, in his own language, to the drum-beat

> The corn grows by the red rock. Beautifully it grows

he could hardly make a plainer or more simple song. In the English translation we miss the drum-beat, we miss the music of the Indian words for corn and rock and the rest. But we notice this: In the first place, the singer has seen something beautiful, something he wishes to share with his fellows. To do so, he does not merely make a direct statement, "I saw six fine ears of corn growing by a red rock." He repeats words for their sound, he arranges a musical pattern of words to fit his idea. So we get the beginnings of poetry.

When we reach a slightly more civilized form of poetry—the poetry of the ballads of the Scottish Border, for instance—we still hear the musical accompaniment with the words:

Ye Hielands and ye Lowlands, O where hae ye been? They hae slain the Earl of Murray And laid him on the green.

We can hear the harper harping the notes and the voice singing. Indeed, this poem has been set to music many times. But the music is in the words as well. Rearrange the words in another way: "Where have you been, Highlands and Lowlands? His enemies have killed the Earl of Murray and laid him on the greensward." The sense is the same, but most of the music has gone. And, with the music, has gone another quality, that of intensity. The first passage, somehow, is not only more musical but more exciting than the second. And intensity, excitement, a keying-up of the mind as the body is keyed to a sudden spurt in a race, is one of the qualities of poetry.

Poetry is beat and rhythm and dance. It does not walk. It runs, skips, soars, flies. It can move as massively as a great ship down the launching-ways; it can move as delicately and subtly as the wind

through a field of grass.

When Ajax strives some rock's vast weight to throw, The line, too, labours, and the words move slow.

And when

High on a throne of royal state, which far Outshone the wealth of Ormus and of Ind . . . Satan exalted sate. . . .

the rich, slow, ponderous words build up the portentous majesty of that evil throne. But when All the girls are out with their baskets for the primrose; Up lanes, woods through, they troop in joyful bands.the whole verse sparkles and dances. You could not say it slowly and gloomily if you wished. There is in it the light-footed hurry of a joyful throng.

It is natural that it should be so. For poetry is primarily a rhythmic thing. In books, as in all writing, it consists of words printed on a page. But these words are meant to be heard with the ear as well as read by the eye. Unless you can find and listen to the rhythm of the words of a poem, you are missing half the poem.

How is poetry written? How "out of three sounds" does the poet make "not a fourth sound, but a star"? Each language and each literature has its own ways. Greek poetry, for instance, was based not upon rhyme but upon beat—upon the beat of certain meters (line lengths), like the surge of waves on a beach-and the ebb and flow of syllables in the individual lines which gave variation to the master beat. English poetry has been strongly rhyming, although it has employed many unrhymed forms, notably blank verse and free verse (vers libre). Each poetry has developed certain rules, certain forms or molds, certain meters which seemed to bring out the most musical and im-

aginative qualities of its own language.

Certain forms die, are revived, and die again. Certain ways of writing poetry are employed by one age, scorned by another, reworked perhaps by a third. Cultivated Frenchmen of the Eighteenth Century, used to the stately classicism of Corneille and Racine, found Shakespeare's work crude, barbarous, and violent. They thought of him as some of our own conventional critics thought of Walt Whitman—the sort of person you shouldn't let into your house because he might wipe his muddy feet on your best carpets. On the other hand, to many of us who are used to English poetry, reading Corneille and Racine is rather like wandering through a vast marble colonnade. We know that it is great, but we miss, in its cool perfection, the warmth, the intimacy, and the color of our own verse. And it is so even among works in the same language. You may like one sort of poetry very much and dislike another extremely. You may, for instance, think 'Paradise Lost' a dull and tedious affair and 'The Highwayman' an exciting adventure. But, before you shut any kind of poetry out of your mind, it is a good thing to see what the poet has tried to do and what sort of tools he has used to build his poem.

A poem must be imaginative enough to stir your own imagination. That is its first necessity; and if it does not do that to you as a reader, it is not a poem for you. It may be a very good poem to another reader

whose mind, so to speak, tunes in on a different wavelength from yours—but that is another matter.

What tools does the poet use to make his rhythmic pattern, the pattern with which he hopes to stir your imagination? He has three chief tools—rhyme, meter. and pattern. He uses them in various combinations.

Rhyme

Let us start with the simplest tool, the one most familiar to us—rhyme. What is a rhyme? A rhyme is a pair of words which end with the same sound but begin differently.

Hickory dickory dock. The mouse ran up the clock.

Dock and clock are rhymes. So are Mary and contrary, Horner and corner, pail, whale, and sail, and thousands more. But soar and sore are not rhymes. They are spelled differently, but the sound is identical; both the beginning- and end-sounds are the same.

In words of more than one syllable, the rhyme must be where the emphasis is. Thus ailing and failing are rhymes, because the emphasis on each word is on ail and fail. But ailing and thing are not true rhymes, as the emphasis in ailing is on the ail sound and the emphasis in thing is on the ing sound. Rhymes, in general, should rhyme to the ear, not to the eye, although in English there is a certain limited class of words that rhyme to the eye and not to the earwind (as we now pronounce it) and blind, for example, or *loving* and *roving*—which usage has made allowable.

And, in modern poetry, particularly, you will find a great deal of assonance-of words like shadow and meadow with similar but not identical sounds.

> Suppose, when you're lonely, There's nought in your kettles But bread broken stonily And serpentish victuals

says Elinor Wylie, in her beautiful 'Grace Before Meat'. Here all four rhymes are assonantal.

But in general the person who is beginning to write poetry-not the expert-should try to make his rhymes as clear and true as possible, if he writes in rhymed form. For rhymes are the bells of English verse, and there are rhymes of every sound and every metal. You can set a whole peal ringing at once, as Poe did in 'The Bells' or as Southey did in 'How the Waters Come Down at Lodore':

Advancing and prancing and glancing and dancing . . . And dashing and flashing and splashing and clashing.

You can ring them against each other, single rhymes against double rhymes:

> So, we'll go no more a roving, So late into the night, Though the heart be still as loving And the moon be still as bright.

You can play tricks with them, as W. S. Gilbert did in his patter songs:

From the greengrocer tree you get grapes and green pea, cauliflowers, pineapple and cranberries, While the pastry-cook plant, cherry-brandy will grant, apple puffs and three corners and banberries.



You can use very simple rhymes, as A. E. Housman does in his perfect

Loveliest of trees, the cherry now Is hung with bloom along the bough, And stands about the woodland ride Wearing white for Eastertide.

Now, of my three score years and ten, Twenty will not come again, And take from seventy springs a score, It only leaves me fifty more.

And since to look at things in bloom Fifty springs are little room, About the woodlands I will go To see the cherry hung with snow.

You can use rather odd ones, as Browning often does:

I the Trinity illustrate
Drinking watered orange-pulp,
With three sips the Arian frustrate
While he drains his at one gulp.

But, whatever your mood, you will generally find a rhyme to suit it. For English is rich in rhymes.

Meter

Meter comes from the Greek *metron* (measure) and is the measured rhythm of a line of verse. The simplest way to define a meter is to call it a series of lines of verse in which each line has the same number of strong beats—places where the voice of the reader stresses a word or a syllable of a word.

"Hickory dickory dock." As you read it, you say "HICKory DICKory DOCK." Your voice makes the stresses automatically. It is like a fist tapping a punching-bag three times. "HICK" and the bag flies away; "DICK" and you strike it as it returns; "DOCK" and the bag flies away for the last time. And when you read the next line, you do the same thing: "The MOUSE ran UP the CLOCK." Three more taps on the punching bag. Then, for variety's sake, the meter changes. "The CLOCK struck ONE, And DOWN he RUN." Only two taps apiece to the line this time. Then a return to the first three-tap meter: "HICKory DICKory DOCK."

The three-tap meter is called *trimeter* (three-foot), the two-tap meter *dimeter* (two-foot). Tetrameter is four-foot meter, pentameter five-foot, and so on, from a meter as short as the monometer (one-foot) to the long octometer and nonometer (eight- and nine-foot). It is a wide range, a wide and varied keyboard.

The stressed and unstressed syllables in a poetic foot are rather like the dots and dashes in the Morse telegraphic code. In scanning poetry—that is, in analyzing it for its rhythm—they are usually represented by the following signs:

=dot=short syllable, unstressed by the voice

-=dash=long syllable, stressed by the voice The syllables are not really long or short in themselves; it is the stress of the voice that counts. Feet are made up of combinations of stressed and unstressed syllables. Some of these combinations are:

-spondee -iambus -anapest -amphibrach -trochee -dactyl -amphimacer Perhaps the easiest way to remember them is from this verse of Coleridge's:

Trochee trips from long to short;
From long to long in solemn sort
Slow Spondee stalks; strong foot! yet ill able
Ever to come up with dactyl trisyllable.
Iambics march from short to long—
With a leap and a bound the swift Anapests throng;
One syllable long, with one short at each side,
Amphibrachys hastes with a stately stride;—
First and last being long, middle short, Amphimacer
Strikes his thundering hoofs like a proud high-bred racer.

Suppose we take two lines and scan them.

John Gilpin was a citizen Of credit and reknown.

Read it and see where the strong stresses are.

John GILpin WAS a CIT-i-ZEN Of CREDit AND reKNOWN

Then divide it into feet and mark the long and short syllables.

John Gil pin was a cit izen Of cred it and reknown.

The first line is iambic tetrameter, the second iambic trimeter. But listen to the beat of the anapests in

I gal loped, Dirck gal loped, we gal loped all three. Here is tetrameter too, but a strongly anapestic tetrameter, making for a much longer line and a differing rhythm.

The great Greek meter was the hexameter (six-foot), the meter of the 'Iliad' and the 'Odyssey'. It has never acclimated itself very well in English, though we have an example in Longfellow's 'Evangeline':

This is the | forest pri | meval, the | murmuring | pines and the | hemlocks.

The meter holding a similar position in English, the meter of Shakespeare's plays and Milton's 'Paradise Lost' is the iambic pentameter (short-long, five-foot meter). When it is unrhymed we give it a name of its own and call it blank verse. Here is Shakespeare.

Once more unto the breach, dear friends, once more Or close the wall up with our English dead and again

The singing masons building roofs of gold and again

Tomorrow and tomorrow and tomorrow Creeps in this petty pace from day to day To the last syllable of recorded time; And all our yesterdays have lighted fools The way to dusty death. Out, out, brief candle! Life's but a walking shadow, a poor player That struts and frets his hour upon the stage And then is heard no more. . . .

Here is Milton.

Of Man's first disobedience and the fruit Of that forbidden tree whose mortal taste Brought Death into the world and all our woe... Sing, Heavenly Muse, ...

and again

Thick as autumnal leaves that strew the brooks Of Vallombrosa, . . .

Here is Robert Frost.

Something there is that doesn't love a wall That sends the frozen ground-swell under it And spills the upper boulders in the sun.

All very different, all wonderfully varied, yet all using the same basic structure.

Pattern

There are certain set patterns in poetry as there are certain regular meters. For convenience in discussing rhyme schemes we indicate identical rhymes by the same letter. A couplet consists of two lines of verse rhyming aa; a quatrain of four lines, rhyming in various combinations. 'We'll go no more a roving' (quoted before) is a quatrain. The heroic couplet is two rhymed lines of verse in iambic pentameter. Alexander Pope, the waspish, superb technician who was one of the most characteristic poets of the reasonable Eighteenth Century, wrote largely in the heroic couplet and made it as trim and telling as the sting of a bee.

A little learning is a dangerous thing. Drink deep, or taste not the Pierian spring.

The Spenserian stanza is named after Edmund Spenser, who wrote the 'Faerie Queene'. It is a form, often used to tell a story, in which each separate stanza consists of eight lines of iambic pentameter, rhyming ababbebe, and a line of iambic hexameter at the end, rhyming c. This hexameter line is called an Alexandrine. The following example of a Spenserian stanza is from Lord Byron.

Roll on, thou deep and dark blue Ocean—roll!
Ten thousand fleets sweep over thee in vain;
Man marks the earth with ruin—his control
Stops with the shore;—upon the watery plain
The wrecks are all thy deed, nor doth remain
A shadow of man's ravage, save his own,
When for a moment, like a drop of rain,
He sinks into thy depths with bubbling groan,
Without a grave, unknell'd, uncoffin'd and unknown!

Perhaps the most famous of the set patterns in English poetry is the *sonnet*. It must consist of fourteen lines of iambic pentameter, rhymed usually in one of two ways. Here is a sonnet on the sonnet itself, by Richard Watson Gilder.

What is a sonnet? 'Tis the pearly shell That murmurs of the far-off murmuring sea; A precious jewel, carved most curiously; It is a little picture, painted well. What is a sonnet? 'Tis the tear that fell From a great poet's hidden ecstasy; A two-edged sword, a star, a song—ah me! Sometimes a heavy-tolling funeral bell. This was the flame that shook with Dante's breath; The solemn organ whereon Milton played And the clear glass where Shakespeare's shadow falls; A sea this is—beware who ventureth! For like a fiord the narrow floor is laid Mid-ocean deep sheer to the mountain-walls.

This sort of sonnet, rhyming abbaabba cdecde, we call a Petrarchan or Italian sonnet, from Petrarch, the great Italian poet. The other customary form of the sonnet, consisting of three quatrains with an ending couplet (abab cdcd efef gg), we call a Shakespearean

sonnet. Here is one of the great Shakespearean sonnets. Notice the difference in rhyme scheme.

Shall I compare thee to a Summer's day? Thou art more lovely and more temperate: Rough winds do shake the darling buds of May And Summer's lease hath all too short a date.

Sometime too hot the eye of Heaven shines And often is his gold complexion dimm'd; And every fair from fair sometime declines, By chance, or nature's changing course, untrimm'd.

But thy eternal Summer shall not fade Nor lose possession of that fair thou ow'st; Nor shall Death brag thou wander'st in his shade, When in eternal lines to time thou grow'st;

So long as men can breathe, or eyes can see, So long lives this, and this gives life to thee.

The first eight lines of any sonnet are called the octave, the last six the sestet. The sonnet is a strict form; a poem with thirteen lines or fifteen lines, though it may be a very beautiful poem, is not a sonnet. Gilder's own sonnet suggests some of the difficulties facing the poet who wishes to bring his sonnet to perfection.

Certain other forms, chiefly those borrowed from the French (the ballade, villanelle, rondeau, and so on), are also very strict patterns. That is the fun of working in them—the fun of working within certain known limits. Outside of these forms, the poet makes his own pattern. He may write a poem as long as 'Paradise Lost' entirely in one meter, blank verse. He may write as Shelley did in 'To A Skylark':

Hail to thee, blithe spirit!
Bird thou never wert,
That from heaven, or near it,
Pourest thy full heart
In profuse strains of unpremeditated art.

Here the pattern in each stanza makes use of more than one meter, more than one sort of rhyme, and plays long lines against shorter ones. But once the form is established, that form is followed throughout the poem. The poet may write, as Matthew Arnold does in the beginning of 'Philomela',

Hark! ah, the nightingale! The tawny-throated! Hark! from that moonlit cedar what a burst! What triumph! hark, what pain!

Here the meter is irregular, the verse unrhymed; it is the rhythmic pattern of the poem which makes the music. In fact, once the poet knows his business, he may do as he pleases, except in the strict forms. He may write in free verse, blank verse, rhymed verse, regular meters, irregular meters. But he must stir your imagination and do it in a way that is not the way of prose. If he writes

At 10:35 Mr. John W. Higgins Went down town to the grocery To get a loaf of bread,

he is not writing poetry but chopping up a piece of prose and arranging it in lines. If he writes, as Whitman did.

As toilsome I wandered Virginia's woods,

To the music of rustling leaves kicked up by my feet (for 'twas autumn)

I marked at the foot of a tree the grave of a soldier;

Mortally wounded he and buried on the retreat (easily all I could understand)

The halt of a mid-day hour when up! no time to lose—yet this sign left

On a tablet scrawled and nailed on the tree by the grave Rold. cautious, true and my loving comrade.

Long, long I muse then on my way go wandering.

Many a changeful season to follow and many a scene of life Yet at times through changeful season and scene, abrupt, alone or in the crowded street,

Comes before me the unknown soldier's grave, comes the inscription rude in Virginia's woods,

Bold, cautious, true and my loving comrade. -

he is writing poetry, though pattern and meter are irregular and there is no rhyme. But there is a music in the pattern, and the poem says more than its words. It is not told in the way of prose.

The Various Kinds of Poetry

There are kinds of poetry as there are kinds of meters. A *lyric* is a brief, intense burst of music in words—"Where the bee sucks, there suck I"; "With rue my heart is laden"; "Come unto these yellow sands." It must mount into the air or it is nothing. A poem 250 lines long, though it might have lyric qualities, would not be a lyric. Lyric poetry is singing poetry.

Elegiac poetry grieves for a dead friend. Gray's 'Elegy in a Country Churchyard', Milton's 'Lycidas', and Tennyson's 'In Memoriam' are elegies. An ode usually deals with an exalted or impersonal subject in a somewhat formal pattern—Keats' 'Ode to a Grecian Urn' and Lowell's 'Commemoration Ode', though quite different, are good examples of the form.

Narrative poetry tells a story. Epic poetry is, or should be, poetry dealing with heroic subjects in a heroic manner. A ballad is direct and simple, a swinging tune about war or love or stirring events— 'The Bonny Earl of Murray' is a ballad. 'Casey Jones' is a folk-ballad of our own; so are such cowboy songs as 'The Old Chisholm Trail'.

Dramatic poetry builds a drama or play. Shake-speare's plays are the best examples of dramatic poetry in English. Didactic poetry is intended to teach a lesson or to point a moral. Pope's 'Essay on Criticism' is of this type.

How to Learn to Appreciate Poetry

The poems we first hear in childhood—the nursery rhymes, the verses in first readers—are usually rhymed poems with a strong, simple beat. Later on we come to poetry that is unrhymed and sometimes, in modern poetry, to poetry that seems at first glance to lack both rhyme and pattern. How can we appreciate this? We must train our ear for it, as we train our ear in music to appreciate counterpoint and harmony. We can do so best by remembering first of all that poetry is meant to be heard as well as read. If a passage or a poem seems unmelodious to you at first, read it over to yourself, aloud or half-aloud, feeling for the music and the pattern that were in the poet's

mind. If in classic poetry you encounter such creatures as Arimaspians, such allusions as "Thee brighthaired Vesta long of vore To solitary Saturn bore." such words and contractions of words as eftsoons. prithee, 'twas, and erst,—find out what they mean, of course, but get the rhythm of the music first. You need not know, for instance, in the lines of Milton's quoted previously, the exact geography of Vallombrosa; the rustling word itself tells you that it is a place where leaves fall thickly in the autumn. You need not know, at first glance, all the technical merits and defects of a poem, any more than you have to know about all the nails in a chair to like the chair. It is a good thing to stretch your mind against the close-packed thought of certain great passages of poetry, but first of all let the words sing to you. If, in modern poetry, certain words and phrases seem to you "unpoetic." remember that poetry is made from live words, current words, not dead ones. It must have the salt and sting of life in it, or it is not great. And remember also that as a modern poet, Archibald MacLeish, has said.

It is true also that we here are Americans:

That we use the machines: that a sight of the god is unusual...

The things of the poet are done to a man alone.

Each age makes its own poetry. It cannot copy the poetry of a past age and produce living work. And poetry is not all in books; some of it is being made today. Only, it must be heard.

The Magic and Mystery of Poetry

For that is the first thing poetry asks—to be heard. After that there are other things. There is the curiously magical effect of certain words, certain sounds, certain images brought together. "Come unto these yellow sands And then take hands." "Old unhappy far-off things And battles long ago." "O, we were sisters, sisters seven! We were the fairest under heaven!" There are lines that stir the mind like a bugle, and lines that fade away into forest-distances, "Annihilating all that's made To a green thought in a green shade." There are lines that seem to hold great wisdom and great peace: "I saw Eternity the other night Like a great ring of pure and endless light All calm as it was bright." But they must be heard before they become part of our minds.

The poet William Blake once wrote: "'What?' it will be questioned, 'When the Sun rises, do you not see a round disk of fire somewhat like a guinea?' O no, no, I see an innumerable company of the heavenly Host, crying 'Holy, Holy, Holy is the Lord God Almighty!' I question not my corporal or vegetative eye any more than I would question a window, concerning a sight. I look through it and not with it."

The difference between those two ways of looking at the sun is the difference between the prose way of looking at life and the poetic way. Not because poetry asks us to live in an unreal world; that is not its purpose. But it can make the world we live in different and more shining.

Poincaré (pwän-ka-rā'), Raymond (1860-1934). Of all the statesmen who shaped the policies of France during the early years of the 20th century, none was more deeply convinced that war with Germany was inevitable, and none had done more to prepare France for the conflict than Raymond Poincaré.

After serving as minister of public instruction and minister of finance, he became premier. This was in 1912, when relations with Germany were strained over Morocco. Poincaré himself took the post of minister of foreign affairs. He followed a definitely anti-German policy and cemented the friendship of France with Great Britain and Russia.

Two years later he was elected president, continuing in this office throughout the World War. President Poincaré was a steadfast influence toward victory, inspiring the people with his own resolution and confidence and supporting every effort made by the responsible civil and military officers. In the Peace Conference he fought for the infliction of harsh terms on Germany.

At the end of his term of office, in 1920, Poincaré was reëlected to the Senate, and three times more he was called on to serve as premier. It was with Poincaré as premier that France marched troops into the Ruhr in 1923 to force reparations payments by Germany. In 1926-28 he stabilized the franc and saved the nation from financial disaster.

Poisonous plants. Every plant in the world has to protect itself if it is to survive, for there are enemies all about it. These enemies may be grazing

animals, or the even more dangerous and destructive insects and fungi. One of the commonest forms of defense is the development of certain qualities within the plant itself which act as protective agents. At times these take the form of thorns, in other cases of evilsmelling substances, and in some instances of poisons which are contained in large enough amounts to make the plants injurious when eaten or even touched.

Among the commonest North American plants which are poisonous to the touch are poison ivy, poison oak, and poison sumac. Contact with any of these is almost sure to cause severe inflammation and an intolerable itching, although people are affected

in varying degrees.

Poison ivy (Rhus toxicodendron), which grows very abundantly throughout the United States as far west as eastern Texas, eastern Kansas, and Minnesota, is the most widely distributed. It is found climbing up the tall trunks of trees and in and out among the

bushes along the road, luxuriating in fence corners. and even thriving in wastes of sand where little other vegetation can exist. Usually it is a trailing threeleafed vine, clinging to its support by a thick fringe of aerial rootlets that appear at intervals along the stem, although sometimes it assumes an upright shrubby growth. Its fresh shining foliage, a charming green even in the driest hottest days of summer, changing in the autumn to rich glowing shades of scarlet, delights the most casual observer; yet its beauty is as nothing to the suffering it causes every year to the thousands who inadvertently come in contact with it. Oddly enough, poison ivy has no apparent effect on animals.

The harmless Virginia creeper, or woodbine, is often confused with poison ivy, but the two are very dissimilar. The Virginia creeper is a stronger larger vine. it has five leaflets instead of three, climbs by tendrils instead of aerial rootlets, and the clusters of berries

are dark blue instead of waxy white.

The poison ivy poison, an oil called toxicodendrol, is found in all parts of the plant, and cases of poisoning can develop at all seasons of the year. It is dangerous to inhale the pollen of the small green flowers which appear in May and June, or to stand in the smoke of burning ivy. To prevent ivy poisoning, use a solution of 5 parts ferric chloride in 95 parts of water and glycerin, equally mixed.

Farther west, the poison ivy is replaced by the socalled "poison oak," a plant of the same genus, which differs from the poison ivy mainly in the character of

its leaves. These are thicker and smaller and less sharply lobed, but the unpleasant effects of touching the plant are the same.

Another beautiful and poisonous member of the same family, the swamp or poison "sumac" or poison "dogwood" (Rhus vernix), is frequently encountered in swampy places from Florida to Canada and westward to Louisiana. The leaves of this shrubby plant which grows from 6 to 30 feet high are pinnate and resemble those of the true sumac of the hillsides and roadways; but the leaflets of the poison sumac are fewer, varying from 7 to 11 instead of from 13 to 30. The

berries are ivory white. A few other plants, not so common, cause skin irritation to some people. Among these is the handsome lady's-slipper growing in sphagnum moss swamps. The juice of several of the spurges (Euphorbia) causes similar inflammation.

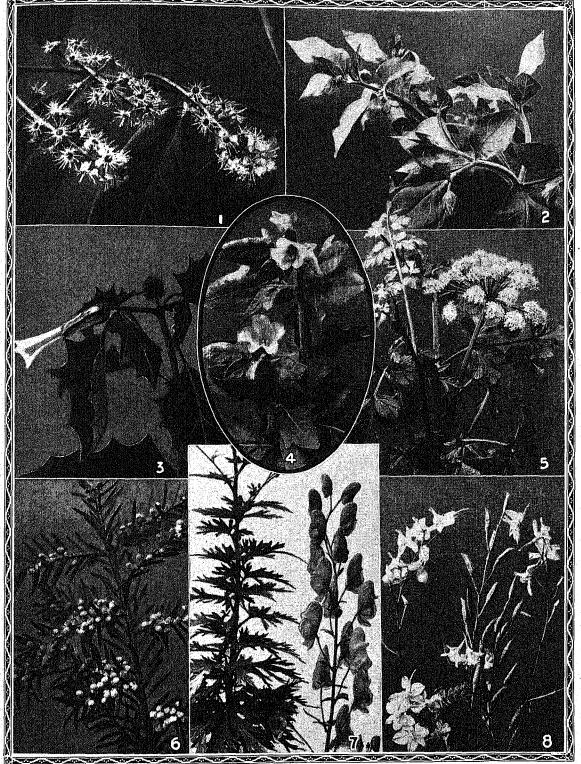
Plants containing substances in their foliage, roots, or fruits, which are poisonous to mankind, are scat-





This plant gets its name from its black rootstock. Its flowers are first white, sometimes tinged with red, but later turn to green. The leaves are evergreen. Hellebore is a corrosive poison.

POISONS THAT GROW IN FIELD AND FOREST



All of the plants shown on this page have been used at some time as medicines, but in large doses they are active poisons. Some of them kill horses, cattle, and other animals, but are seldom fatal to human beings because the latter are not likely to absorb enough of the poison accidentally. The plants are (1) Cherry-Laurel; (2) Deadly Nightshade; (3) Jimson Weed or Stinkweed; (4) Henbane; (5) Water Dropwort; (6) Common Yew; (7) Monkshood or Aconite; (8) Larkspur. The roots of Henbane, Water Dropwort, and Monkshood are poisonous; of the other plants the fruit or foliage is dangerous.

THE POISON SUMACH

tered all through the vegetable kingdom, and the line between such poisonous and non-poisonous plants is not sharply defined. Some harmless plants contain

traces of poisons which, if concentrated, are deadly; the potato, which is one of our most wholesome food plants, though akin to the deadly nightshade, is in this class. The foliage or seeds of some of our loveliest and commonest garden flowers, such as the larkspur, clematis, lupine, and many of the lilies, contain poisons, but they are not dangerous because they are seldom or never eaten. The plants with poisonous fruits, including the pokeberry, bittersweet, nightshade, black cherry kernels, and the deadly "thorn "jimson" weed, apple" or cause the most harm, especially to curious children. Poisonous toadstools, mistaken for true edible mushrooms, are often the cause of death.

Live stock are often made ill by eating poisonous plants growing wild in the grazing

pastures. The "water hemlock" (Cicuta maculata) is probably the most deadly of these, and in fact is the most poisonous of all our native plants. It is especially dangerous because the fleshy carrot-like root, in which the poison is most concentrated, is sometimes eaten by children. Even water in marshes where these roots have been crushed by trampling is poisonous to cattle. The "poison hemlock" (Conium maculatum), which really belongs to the parsley family, is the plant from which the poison was distilled with which Socrates was put to death. The beautiful evergreen mountain laurel, the rhododendron, the dainty buttercup, the sneezewood, rattlebox, and the silvery-white silky-leaved "loco" or crazy weed, are all harmful to live stock.

Many plants, when bruised and thrown into water, have the power of stupefying or killing the fish there. The bruised twigs and seeds of the red buckeye, for instance, thrown into small ponds, will bring the fish to the surface. Other poisonous plants are still used for this purpose by certain South American Indians. Poisoned arrows, used by savage tribes in almost every part of the world, were usually dipped in the poisonous juices of some plant, though snake venom and other poisons were also used. There are several trees in the tropics the bark of which exudes a poisonous sap when wounded.

POISONS. Popular accounts of certain periods of history are crowded with romantic and sensational stories in which poisons play a leading part. The Renaissance period in Europe, and particularly in

Italy, is pictured as a time when tyrants and unscrupulous statesmen were much engaged in administering subtle death-dealing drugs to dangerous rivals and

other inconvenient persons. They had poisons, we are told. which they had only to rub on paper, cloth, or metal to make these fatal to any who touched them, and they compounded delicate perfumes which brought lingering death to those who breathed their aroma. Next to the Italians. the mysterious men of India. are ranked as leading inventors of murderous compounds. Fiction stories and sometimes newspaper reports relate tales of "strange Eastern drugs" which baffle modern science.

These and most statements of a similar character may be dismissed as purely imagination. It is not to be supposed that either the Renaissance Italians or the Hindus carried their knowledge of chemistry beyond what we know today. In fact, the ordinary drug clerk

probably possesses information on the subject which might have brought lasting fame to any Renaissance poison-maker.



Few can touch the leaves or berries of this beautiful shrub without being poisoned.

The Four Classes of Poisons

There is little mystery about poisons today. Although the action of many complex poisonous substances, like snake venom or the ptomaines, may not be fully understood, their general nature and their ordinary effects are known. The common poisons are usually classified according to the way they act upon the human body: (1) corrosive poisons, (2) irritant poisons, (3) nerve poisons, and (4) gas poisons. Substances which are used to counteract the effects of poisons are called "antidotes."

The corrosive poisons are those which "burn" the skin or lining of the stomach. Among the commonest and the most dangerous chemicals of this class is corrosive sublimate, often called bichloride of mercury, which is widely used as an antiseptic. It is prepared usually in the form of small white tablets, and is easily mistaken for harmless pills. For this reason it is unsafe to leave such tablets where other medicines or drugs are kept. The antidote is the white of eggs beaten up with water. Other common corrosives are sulphuric, nitric, hydrochloric, and oxalic acids, all of which act rapidly and powerfully if strong solutions are swallowed. The antidote for these is powdered chalk or even plaster from the wall. Carbolic acid is another corrosive poison which claims many victims. To counteract it, Epsom salts should be given, followed by sweet oil.

The irritant poisons are those which set up inflammation in the body and interfere so seriously with its functions as to cause severe sickness or eventual death. They are usually slower and more uncertain in their action than other poisons and for this reason harder to detect and to avoid. To this class belong most of the so-called cumulative poisons, those which can be absorbed little by little into the system with-

out apparent harm, until suddenly they strike down their unsuspecting victims.

Arsenic and all its compounds are the most important of the irritant poisons. A tablespoonful of dialyzed iron at halfhour intervals is the antidote. Many lead, copper and zinc compounds also fall in this group. Aloes and croton oil are good examples of the vegetable irritants. Phosphorus, which is sometimes used for match tips, is among the dangerous chemicals of this class (see Matches). Ordinary gum arabic mucilage is a good phosphorus antidote.

The most deadly of all poisons, however, are those which act directly upon the nerves. Of these prussic or hydrocyanic acid is perhaps the best known. Less than a teaspoonful of a 2 per cent solution will cause

death. The fumes of this acid are sometimes used to rid dwellings of germs or vermin (see Antiseptics). But only professional experts should ever attempt this, for one or two breaths of the fumes will kill almost instantly. Many cyanide compounds, especially cyanide of potassium, are extensively used in the arts. Most of these are just as poisonous as hydrocyanic acid.

Aconitin is an exceedingly deadly poison, which kills in very minute doses. It is derived from certain plants of the aconite family, some of which, such as the monk's-hood or wolf's-bane, are cultivated for their beauty; most of them are poisonous. Antidotes for this as well as for prussic acid are of little use, as the victim is usually dead before they can be applied.

Other common nerve poisons are opium and all its products, such as morphine and laudanum. The best treatment for these poisons is to keep the patient awake by shaking or even beating and by making him inhale ammonia fumes from time to time until a physician can be summoned. This applies equally to all narcotic poisons, such as cocaine, heroin, etc.

Belladonna and its alkaloid atropine, which is used by oculists to enlarge the pupils of the eyes for examination, is a nerve poison. This drug and morphine are antidotes for each other. Belladonna is obtained from a plant called the deadly nightshade, which has bright scarlet berries often attractive to children.

Strychnine deserves especial warning mention in this group of poisons, because it is so frequently used to get rid of rats, and in the West to kill wolves, coyotes, prairie dogs, and other animal pests. Its effects are very rapid, resulting in convulsions and death within half an hour. Sodium bromide is some-

> times used as an antidote. The best method is to keep the patient under chloroform until the poison has been eliminated.

Gas poisons may be divided into two classes: those which act as powerful irritants to the throat and lung tissues, like chlorine, bromine, the fumes of burning sulphur, and the nitrous vapors produced in copper engraving; and those which act on the blood through the lungs and render it incapable of conveying oxygen.

Ordinary coal gas, used for light and fuel, is, of course, the commonest of gas poisons. The poisonous effects are usually due to carbon monoxide, an important constituent. The treatment is fresh air, aromatic spirits of ammonia, or some other stimulant. Burning charcoal is also dan-

gerous, because of the carbon monoxide it produces. Carbon dioxide, however, is not a true poison, for its effect is merely to cut off the proper air supply and smother the person who is submerged in it. (See Carbon Dioxide and Monoxide.) Gas poisons, principally of the irritant kind, played a large part in the World War of 1914-18. (See Gas Warfare.)

There are many other kinds of poisons, such as the botulism toxin, produced by the growth of Bacillus botulinus, a germ found in spoiled foods; and other bacterial poisons, like those which cause lockjaw. (See Antitoxins; Bacteria; Germ Theory of Disease.) Many animals and plants also secrete poisonous substances (see Poisonous Plants; Snakes).

In dealing with all cases of poisoning from whatever cause, the first rule is to call a physician as soon as possible. While waiting for help, it is well to make the patient vomit by giving an emetic of powdered ipeac or mustard water, or even soap suds, except when the poison taken is lye, caustic potash, washing soda, or any of the corrosive acids. In all gas cases fresh air is the first requisite. Lung action may be aided by working the arms over the head and back. The best way to avoid accidents is to keep no poisons in the household, except when absolutely necessary, and then to have them locked safely away.



This is a twig of the tree called Strychnos Nux Vomica, which is a native of Asia. From its seeds strychnine is manufactured. This drug is used in very small quantities as a heart stimulant, but in larger doses is one of the deadliest of poisons.

The TRAGIC STORY of POLAND

Its Ancient Glory and Its Destruction by Greedy Neighbors-How It Regained Freedom after the World War of 1914-1918 Only to Pass Again under Foreign Domination in 1939

POLAND. Out of the ruins of the World War of 1914-1918 was rebuilt the ancient state of Poland. Since 1795, when it was sliced in three pieces

and divided among its neighbors. Poland had existed only in the flaming nationalism of its people. Again and again the Poles tried desperately to re-create their nation. Even those who had emigrated to distant lands kept alive this ideal. Finally, after a century and a quarter of foreign rule, the Treaty of Versailles in 1919 placed a restored Poland on the map of Europe.

For 20 years this new Poland strove to make its place secure among the nations. It was poor; and many of its people. ground down under generations of oppression, were ignorant and unprepared for the responsibilities of sharing in a democratic government. But it was gradually finding solutions for these and other problems, when suddenly in 1939 it was again wiped off the map and partitioned between Germany and Russia.

Poland before the Partitions

In the 18th century Poland was, next to Russia, the most extensive country in Europe. But its kings were elected by the nobles and at each successive election the power of the crown was diminished, so that in time the king became practically powerless. Poland had no ambassadors at foreign courts, no

fortresses, no navy, no roads, no treasury, no fixed revenue. The officers of the government were appointed for life and could not be removed. The Diet. or legislative body, which had all power of making peace or war and levving taxes, was composed exclusively of representatives of the nobles. By what was known as the liberum veto, any one of these could rise

and exclaim, "I disapprove," and so defeat any measure which came before the Diet. There was no middle class in the population of about 1,000,000 nobles and 13,000,000 serfs, and the peasants were "the poorest, most oppressed, and most miserable in the world." The estates of many of the nobles were so small that it was jokingly said that when the noble's dog lav down in the middle of the estate, his tail would extend beyond its borders.

Poland's greedy neighbors to the east, west, and south blocked every effort to reform this state of affairs. Then Catherine II of Russia determined to seize a portion of Poland, and Frederick the Great of Prussia persuaded Austria to join him in forcing Catherine to share with them the booty. Thus began the "vast national crime," by which in three successive partitions—

in 1772, 1793, and 1795-Poland was wiped off the map and its territories annexed to Russia,

Prussia, and Austria.

The new Poland created by the Treaty of Versailles in 1919 regained approximately her old western boundary, including the Vistula River basin, but with the port of

Danzig made a "free city" (see Vistula River); and the Allenstein and Upper Silesian districts were to vote upon their future allegiance. The eastern limits fell far short of their former place. Poland, however, upset



This is a Polish woman of the poorer class. The wealthy women often wear bright red boots, especially when dressed in their "Sunday-best."



On the outskirts of Cracow this green mound stands boildly against the skyline. It is a monument to Poland's great hero, Thaddeus Kosciusko. Earth from every corner of the land was brought by the people and heaped here day after day from 1820 to 1823. There is soil from the battlefields where the patriot fought, and from the people's own lands, all carried here in baskets, boxes, barrows, or even in bare hands. The mound itself is 100 feet high, and stands on top of Borislava Hill (1,003 feet).

KID THE TOWN

these arrangements. Defeating the Russians, the Poles forced them to accept a boundary running between Minsk and Pinsk (treaty of Riga, confirmed March 18, 1921). Allenstein voted to remain German, and after a riotous plebiscite, the League of Nations divided Upper Silesia between Poland and Germany.

The Polish villages of the country districts consist usually of two straggling rows of thatched one-storied stone huts, plastered with mud and turning their gable ends to the uncobbled street between. Sometimes the houses are white-washed and daubed with gay paints. If the village is large, there is a church—usually

"THE COSSACKS ARE COMING!"



In the days of Russian rule, when the inhabitants of a Polish city rose in protest against oppression, the reply was often the brief order: "Send the Cossacks!" And presently down the streets would gallop a band of these wild and ruthless horsemen, armed with whips or with sabers drawn. Through the town would ring the cry of terror: "The Cossacks are coming!" while the people ran for shelter. And so with lash or steel the Poles were beaten into submission. In this picture we see such a scene. In the foreground a terrified mother turns away from what seems certain death for her child, but a gallant passer-by, even under the horseman's blows, saves the little girl.

Meanwhile Polish troops had seized Wilno (or Vilna) in October 1920, and had set up a Polish government. Early in 1922 the Vilna Assembly voted to join Poland, and in spite of Lithuanian protests, Poland ratified the annexation April 18, 1922. These events gave Poland an area of about 150,000 square miles, and a population (1931 census) of 32,120,000.

The Land and the People

Despite long winters, wet springs, and marshy areas, the northern two-thirds of Poland yields fair crops of rye, oats, wheat, barley, sugar beets, and Southern Poland has coal and iron in Polish Silesia, and brown iron ore, coal, lignite, zinc, tin, copper, and sulphur. Eastern Poland is rich in live stock, petroleum, and timber, and produces textiles, beet sugar, leather, and leather goods. Warsaw, the traditional capital, is the largest city (see Warsaw). Lodz, next in size, has important cotton manufactures. Cracow has a famous university (see Cracow), and Posen (Polish Poznan) has distilleries and milling interests. Lemberg (Lwow) is an industrial and commercial city, and a shipping center for the oil fields and farm lands to the south. Realizing the need of a port which it could use for military purposes, Poland created a new port at Gdynia, 12 miles northwest of Danzig, and diverted to it much of the nation's foreign trade.

Roman Catholic, but often "Uniate" (Greek Catholic, though under the pope)—and a pond where geese, ducks, pigs, and babies wallow contentedly, and where the village laundry is done, even in mid-winter. Inside the houses there are usually two rooms. In the first, the "hot room," the whole family, sometimes several generations, eat, sleep, and work. Its few pieces of furniture are wooden benches and tables, their originally glaring colors mellowed by smoke and dirt; and an enormous brick stove reaching almost to the ceiling, in which logs and blocks of manure are burned. The windows let in light but never fresh air, and above the stifling heat and stuffiness is an overpowering odor of sour cabbage and garlic-flavored beet-root stew. From the other room, the "cold room," there emerges at daybreak a procession of perhaps two cows, a pony, surely several dogs, some pigs, and much poultry.

The peasants are of Slavic stock more or less mixed with other races. Their costumes are often very picturesque. The men usually wear buff woolen breeches, a jaunty short coat decorated with scarlet and blue ribbons, and a small round black felt hat. Their sweethearts appear wrapped in a flaming rose and yellow shawl, beneath which you catch glimpses of an embroidered green velvet bodice and a full white linen skirt reaching barely to the knees, with high-

heeled boots of crimson leather stitched with yellow. They wear beads of every hue, long silver earrings, and bright-colored kerchief head-dresses which lend addiand hostile neighbors. This has made Poland one of the bloodiest battlegrounds of Europe. In the World War of 1914–1918 two and a half million Polish-speak-

ing soldiers fought one another in the armies of their Austrian, German and Russian masters. German troops, invading Russian Poland, destroyed factories and laid waste the fields and farms. Entire districts were completely depopulated by cold, starvation, and disease. Hardly had the Polish people repaired the ravages of the World War when in 1939 Germany again invaded their country and wrote another chapter in its tragic history, wrecking its industries and confiscating its wealth.

The World's Debt to Poland

But whether under alien rule or free, the nation's spirit has never been crushed. In the hearts of the people still lives the idealism which sent John Sobieski and his warriors in 1683 to battle for Christianity against the Turk before the walls of Vienna, saving Western Europe from the blight that comes with the Ottoman; and which brought Kosciuszko to

Washington's aid in the American Revolution. And it is not warriors only

A MAP HISTORY OF POLAND

Stockholm V 11 Haval

Besthonia Ring And Ring And

From 1921 to 1939, when it once again disappeared from the map of Europe. Poland occupied all the uncolored area on the map above, except Lithuania. At the right is a Polish peasant trudging to market with a scrawny cow and a duck.

tional glory to their costume and bring out the ivory-tinted pallor of their small oval faces and the dark brightness of their long-lashed eyes.

Problems Within and Without

One of Poland's most difficult problems grew out of the existence of large racial minorities. More than a third of the population of the Polish state of 1919–39 consisted of non-Polish peoples. Of these there were about

3,000,000 Ukrainians, 1,000,000 Ruthenians, 1,000,000 Russians, 750,000 Germans, and almost 3,000,000 Jews. The Polish government did not treat these groups with generosity and was particularly harsh in its treatment of the Jews.

Another grave problem was the country's situation in the heart of Europe, surrounded by powerful that Poland has given the world. Her intellectual and artistic life has kept steadily on. Think what has been Poland's contribution to beauty and

knowledge in the genius of Mickiewicz, her immortal poet; of Sienkiewicz, whom we know best as the author of 'Quo Vadis' and 'With Fire and Sword'; and Joseph Conrad, one of the master story-tellers of the English language. Recall that Madame Curie, the discoverer of radium, was a Pole; and that this nation also produced the composer Chopin, the pianist-

composer Paderewski, the singer Sembrich, and Modjeska the actress, together with hosts of other persons eminent in one or another of the arts.

Poland through Nine Centuries

Poland (the name means "plain") became a Christian kingdom about A.D. 1000. From the 13th century on there were wars with the crusading order of Teutonic Knights, who had colonized the Baltic coast, and with the Mongols, who then ruled Russia. The area of the kingdom was more than doubled when it gained the Grand Duchy of Lithuania in 1386.

After its partition in 1795, Poland, except for its brief and partial resurrection as the Duchy of Warsaw (1807–13), was absent from the map of Europe until the end of the World War of 1914–1918. The independent republic of Poland was proclaimed in November 1918. General Josef Pilsudski became head of the provisional government and appointed Paderewski premier (see Paderewski, Ignace Jan). When succeeding governments proved too weak to cope with the problems of the young nation, Pilsudski seized power and ruled as a dictator. After his death in 1935, President Ignacy Mościcki, Marshal Edward Smigly-Rydz, and Colonel Josef Beck shared control.

Poland's chief problem was to steer a safe course in the diplomatic struggles of its powerful neighbors. In this it failed, for Germany at last denounced the nonaggression pact it had signed with Poland, demanded the annexation of Danzig to the Reich, and asked for a strip of territory across the Polish Corridor between East Prussia and the rest of the Reich. When Poland, backed by pledges of support from England and France, refused these demands, Germany on Sept. 1, 1939, invaded the country.

Cut off from its allies in the west, Poland alone was no match for the mighty German military machine. Bombed from the air and assailed by swift-moving mechanized units, the Poles were conquered within three weeks. The final, crushing blow came on September 17, when Soviet armies attacked on the east.

On September 29 Russia and Germany concluded the fourth partition of Poland. Germany took the western part, containing about 45 per cent of the area, 60 per cent of the population, the major industrial centers, and the best farm land. A new Polish "government in exile" was set up in France. Later, after the defeat of France, headquarters were transferred to London. (See also Danzig; World War, Second.)

The ROMANCE and TRAGEDY of POLAR EXPLORATION



Far in the frozen North a handful of heroic men are struggling onward toward the Pole. The cold is terrible, 50 degrees below zero. A hurricane is blowing, hurling bits of ice and snow against the frozen cheeks of the men. In their heavy furs they stagger on, slipping on the ice, crossing crevasses where the least misstep means certain death. Their supplies of food are only the barest amount that can sustain life. And yet, because of the courage which is in them, they will not turn back. In quest of the Pole men have laid their bones along the Arctic and the Antarctic shores for centuries. They have faced untamable nature in her last stronghold and they have conquered. Such is the spirit of Polar Exploration.

POLAR EXPLORATION. The history of polar exploration goes back many centuries. It starts perhaps with Ottar, that friend of King Alfred of England who with his Northmen discovered the White Sea, and with his yet more venturesome countryman, Eric the Red, who colonized Greenland a century later. From those early days to this, the great frozen spaces about the poles have called men to heroism and

death, and their trails have led over ice-pack and glacier, through strange waters and over ice-bound mountains. (See Arctic Regions.) Many nations have contributed leaders to these explorations or equipped their costly expeditions—Norway, England, Denmark, Holland, Russia, Sweden, the United States, Germany, Japan, Austria-Hungary and Italy. So many are the gallant men who have taken

MATERIAN PARTICULAR

part in the work of polar exploration that not even their names can here be given; only the greatest of the expeditions and achievements can be touched upon.

In the exploration of the north polar regions one of the first of the great names is that of Sir Martin Frobisher, a courageous gentleman of Queen Elizabeth's day who believed the polar seas were full of devils, but none the less sailed into them and discovered Bay on the Frobisher coast of Arctic America. He didn't find the "northwest passage" to China, for which he was looking, but he was one of the founders of the British Empire. After him came Davis and Baffin, Englishmen, and Bering, a Dane, whose discoveries you can see for yourself by looking on the map where they have left their names. Henry Hudson, another Englishman, also left an imperishable name in geography before he met his sad end. He and many who followed him worked for two great English trading companies, the Muscovy Company and the Hudson's Bay Company, which did a great deal

for exploration. Navigation in those days was very difficult, not only because of the tiny ill-fitted ships used, but also because of the woeful lack of knowledge of the day. Hudson wrote quite seriously in his log that his men had seen a mermaid. Everyone believed in devils and evil spirits, and, what was perhaps worse yet, the charts were all terribly wrong. Whole lands,

invented out of whole cloth and drawn in the charts, confused navigators for centuries.

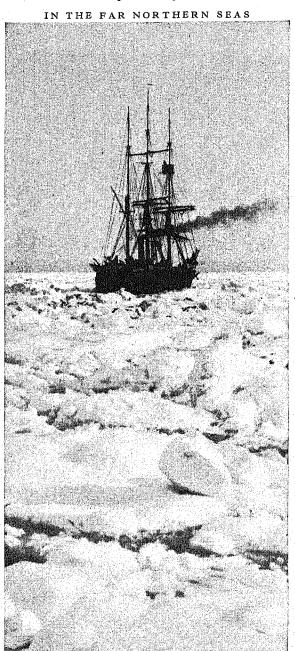
In 1831 Capt, James Ross found the north magnetic pole on the west shore of Boothia Peninsula. An ill-

fated expedition headed by Sir John Franklin did more for polar exploration in the end than any other single factor in the 19th century. The expedition

sailed from England in 1845 to find the northwest passage, and, after three years of hardships and disaster, came to an end on the shores of Boothia. The relief expeditions which were sent out to ascertain the fate of these men discovered and explored 7,000 miles of Arctic coast line. One of these expeditions was led by Capt. Robert McClure. His ship was caught in the ice off Banks Land, but he pushed on with his crew across the ice and was finally rescued by another expedition which brought him home to England in 1854. He had discovered and traversed, though not in the same ship, and partly across ice, a northwest passage; and for this feat he was knighted and a reward of £10,000 was granted him and his crew by the House of Commons.

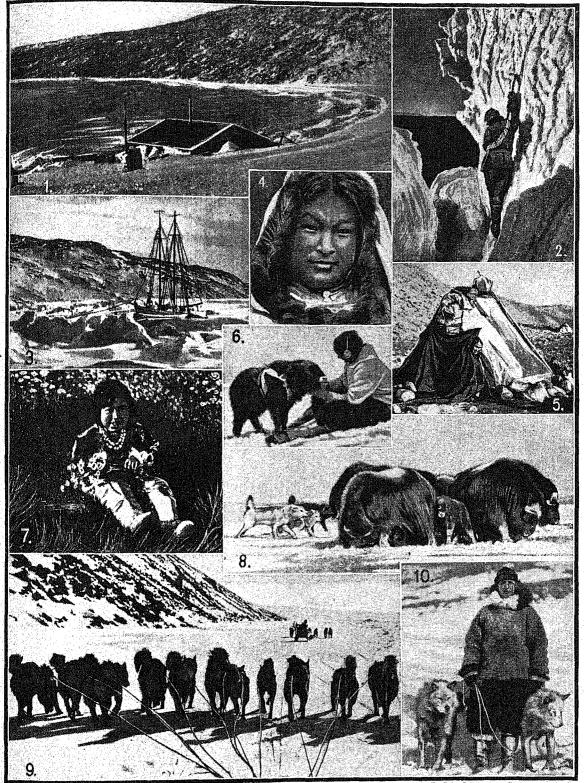
The United States was the first of seven nations to establish stations in the far north for scientific observations. In 1881 an expedition under Lieut. A. W. Greely began work on the eastern shore of Grantland, 497 miles from the pole. Through the failure of relief ships to reach the party, 18 of the 25 men died of starvation at Cape Sabine, and one later at Disco. The survivors, however, brought back valuable scientific results as well

while the North American polar regions were thus being explored, the European and Siberian shores of the Arctic Ocean had also been investigated, at first in the search for a northeast passage and later for



Fast in the Arctic ice is this ship, one of those belonging to the exploring expedition led by Vilhjalmur Stefansson in 1913-1916 on behalf of the Canadian government. For months at a time the explorers' ships are held in the grip of the ice, waiting for the summer thaw which will enable them to push on.

SCENES IN THE LIFE OF A POLAR EXPLORER



Most of these photographs were taken during the expeditions of the famous explorer, Capt. Donald B. MacMillan. 1. Station at Etah, northwest Greenland. 2. Climbing icebergs. 3. MacMillan's ship, "The Bowdoin," caught in the ice. 4. A typical Eskimo girl. 5. Eskimo summer quarters. 5. MacMillan playing with a baby muskox. 7. An unexpected sight—picking flowers above the Arctic Circle. 8. Muskoxen forming a circle to protect their young from dogs. 9. A dog team on the trail. 10. MacMillan with two favorites.

EMBALLY.

scientific purposes. Spitzbergen (Svalbard), Fridtjof Nansen Land, and Nova Zembla (Russian Novaya Zemlya) were charted. Then men turned their attention more and more to the Pole itself. Of the numerous attempts to reach this goal, one of the most interesting

was that made by the Norwegian scientist, Fridtjof Nansen.

Dr. Nansen had noticed that objects, such as driftwood and a pair of trousers lost from a wrecked steamer. drifted from the coast of Asia across the Arctic Sea and arrived finally in the North Atlantic, between Greenland and Europe. On this and other grounds he decided on a most daring course. He constructed a ship named the Fram, making it especially strong to resist crushing by the ice, and shaping it so that the cakes meeting would lift the ship out of water on top of the ice. In this ship in 1893 he allowed himself to be frozen into the ice-pack north of Siberia, with a company of 13 men. For three years they slowly drifted westward. Nansen was quite right in his theories.

and they came out just about where he had expected they would, with a real harvest of scientific information and everyone in the best of health. The only disappointment was that they did not drift quite far enough north to touch the Pole itself. Nansen himself, therefore, with one companion left the ship and dashed for the Pole, but was unable to get farther than 86° 14' N. Four years later an Italian expedition under the Duke of the Abruzzi made a dash across the ice from Fridtjof Nansen Land to 86° 34' N., a little nearer the Pole than Nansen.

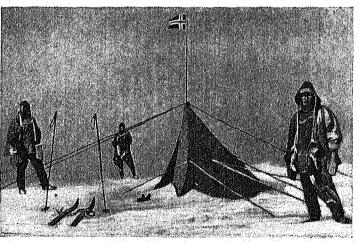
Of the many tragic mysteries of the frozen North, one of the most baffling was the fate of the Swedish

aviator, S. A. Andree, who on July 11, 1897, set out from Spitzbergen in a frail balloon with two companions, Nils Strindberg and Knut Frankel. They hoped to reach the North Pole. A carrier pigeon and several buoys brought messages from them for

AT THE ENDS OF THE EARTH-VICTORY AT LAST

On April 7, 1909, Peary, with Matthew Henson, his negro assistant, and four Eskimos, reached the North Pole and hoisted the American flag on a mound of ice.

This picture, taken by Peary, shows Henson in the middle.



On December 14, 1911, Amundsen and four comrades reached the South Pole, erecting there this tent surmounted by the flag of Norway. A month later Captain Scott found these tokens before he started on his tragic return trip.

a few days; then nothing more was heard for 33 years. In August 1930, Dr. Gunnar Horn and a Norwegian exploring party found the bodies of Andree and his aids, their camp, a boat, sledges, and instruments, on barren White Island, in Franz Josef Land (now Fridtjof Nansen Land). Unusually light snows in a year of rapidly melting ice had revealed their fate at last. They had survived the failure of their balloon, only to die of hunger.

But the real hero of north polar exploration is the American naval officer. Robert E Peary. For 18 years he tried, heading eight expeditions. and was finally rewarded by the victory. His story is told in this work under his name. When Peary arrived in civilization in 1909, after having reached the North Pole, he

found the world raging with controversy over the claim of Dr. F. A. Cook that he had reached the Pole a year before Peary. Cook's story was generally rejected, and Peary was hailed as victor in the quest that had lured men for so many centuries. (See Peary, Robert Edwin.)

South Polar Explorations

The Antarctic regions, around the South Pole, were not explored to any extent till after the north polar regions were well charted. The South is farther from the center of European civilization, and the climate there is more severe than in the North. Instead of being, like the North Pole, on a sea sur-

rounded by land, the South Pole is on a vast continent surrounded by sea. It is very difficult to reach this continent because of the Great Ice Barrier

which surrounds it, so that the early explorers merely touched here and there, discovering a few small islands outside the polar circle. (See Antarctic Continent.)

The work began with Capt. James Cook, who in 1772-75 sailed entirely around this region, but at only two points-in the South Pacific-penetrated the Antarctic Circle. Other men, including the American naval officer Charles Wilkes (1838-42), carried these explorations further, and in 1840-43 Sir James C. Ross discovered Ross Sea and formally took possession of South Victoria Land for the British government.

In 1902 Capt. Robert F. Scott, of the British navy, made the first explorations ever made on land in the Antarctic. Starting from South Victoria Land he penetrated some distance into the interior, discovered

a chain of mountains, several glaciers, etc., and did much valuable scientific work. Another English naval officer, Sir Ernest Shackelton, got within 97

AN ECLIPSE VIEWED FROM NEAR THE POLE



Captain Scott's party made many valuable observations and obtained data of great scientific value. This is Lieutenant Evans watching the passage of some other heavenly body across the planet Jupiter. Many astronomical phenomena can be best seen from the northern and southern polar regions.

miles of the Pole in 1907-09. At that time, two members of his party, Sir Edgeworth David and Sir Douglas Mawson, succeeded in locating the south magnetic pole. On a second expedition Captain Scott actually reached the South Pole, Jan. 18, 1912, only to find that Amundsen had been a few days before him. In one of the most tragic and heroic stories of history. Scott and his party

The glory of discovering the South Pole falls to Roald Amundsen, a Norwegian explorer who had already won honors in the Arctic. One dark

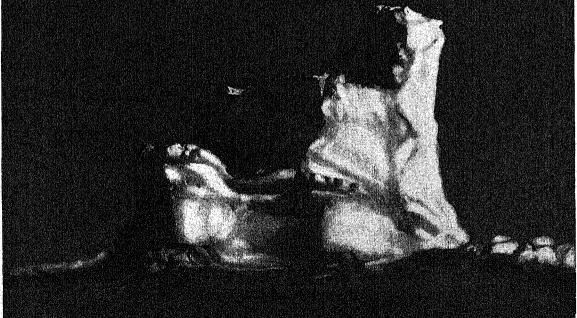
perished on the way back

to their ship (see Scott,

Robert Falcon).

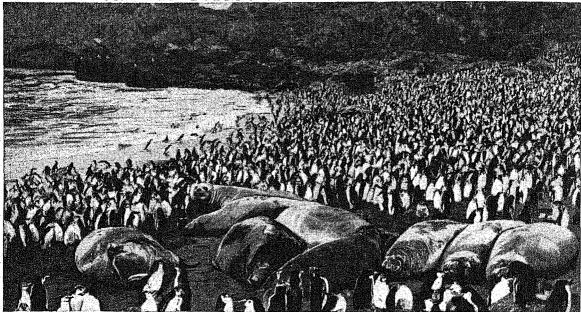
day in December 1905, his dog-sled had dashed into Eagle City, Alaska, having traversed the icy wastes which separated that outpost of civilization from his little ship the $Gj\ddot{o}a$, then frozen in near Boothia

"CASTLE BERG" AND ITS SHINING TOWERS



This is one of the strangely shaped masses of ice photographed by Captain Scott's Expedition. Like some feudal castle it rises from the frozen Antarctic waters. In the foreground is one of Scott's dog sleds.

YOUNG SEA-ELEPHANTS AND ROYAL PENGUINS



This grotesque assemblage was photographed by Sir Douglas Mawson's expedition on Macquarie Island, which lies about 600 miles south of New Zealand. From this photograph it is easy to see why a colony of Penguins at a distance resembles a crowd of human beings. The Sea-Elephants have come ashore for a nap, but the Penguins are not in the least disturbed by their bulky visitors. miles south of human beings.

and conducting observations on the north magnetic Returning the way he had come, Captain Amundsen next spring brought his little vessel and

total of five companions through the Northwest Passage to the Pacific—the first ship to complete the passage. (See Amundsen, Roald.)

The South Pole at Last!

Four years later, in Nansen's ship Fram, Amundsen sailed south to conquer the South Pole. He wintered at the Bay of Whales, on Ross Sea, spent the following summer establishing three supply depots on the way to the Pole, and the following winter gathering 132,-000 pounds of seal meat for the dogs and baking 42,000 loaves of hard bread for the men. Then, on Oct. 20, 1911, after having made one bad start, he commenced his final dash. He reached the Great Ice Barrier surrounding the 10,000 foot high polar plateau on

Nov. 17, and the Pole on Dec. 14. After three days spent taking observations, he made the return trip without mishap, and the following March the world heard of his glorious achievement.

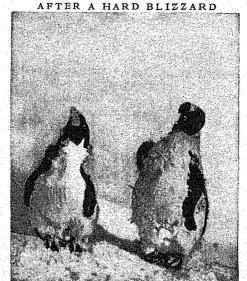
But even then the urge to reach the Poles did not end. Various attempts to reach the North Pole by

balloon and airplane had failed; but in 1926 this method of exploration was crowned with success. The first flight was made by Lt.-Com. Richard E. Byrd,

of the American Navy. Flying from Spitzbergen on May 9, Byrd made the trip to the Pole and back (about 1,600 miles) in 15 hours, 30 minutes. Three days later the North Pole was again crossed, this time by Amundsen in a dirigible piloted by Col. Umberto Nobile of Italy. The trip from Spitzbergen to Teller, Alaska, took 71 hours.

In 1928 Capt. George Hubert Wilkins flew in an airplane from Point Barrow, Alaska, to Spitzbergen (about 2,200 miles) in 20 hours. Nobile reached the North Pole again in May 1928, but his dirigible Italia was wrecked and eight of the crew lost on the return trip. Amundsen and five others who flew to the rescue perished in the attempt.

These flights awakened the nations to the vast commercial and military possibilities of air routes in the Arctic. By comparatively short flights across the Polar Sea Canada can reach Russia; northwest Europe is joined closely to the Far East; and Alaska becomes a near neighbor to Siberia and North Russia.



These Penguins are freeing themselves from snow and ice after a storm.

THE QUEEN MAUD RANGE, ICE-LOCKED MOUNTAINS OF THE ANTARCTIC



Ribbed with ice, gnawed by fierce winds, the Queen Maud mountain range was one of the many perilous mountain barriers which Admiral Byrd had to cross on his historic flight over the South Pole on Nov. 29, 1929. Forced landing on such slopes meant death.

POLAR NIGHT IN THE BAY OF WHALES

Already airplanes are flying furs from Siberia to Alaska, cutting to a fraction the time of the old around-Europe route of that trade. The shortest air route between England and Canada is across the Arctic, over the Faroes, Iceland, Greenland, and

Baffin Land. The longest stretch of sea flying over this route is only 300 miles, and over four-fifths of the way there are natural emergency landing fields. The 500-mile ice cap across Greenland is the greatest barrier to this route.

Russia's North-Pole Base

Soviet Russia has taken the lead in the development of Arctic air lanes. In May 1937, Russian planes flew to the North Pole and established a base there on an ice floe. A party of four men was left, with a year's supplies and a radio with which they sent out daily weather reports. In June of the same year, and again in July, Russian planes made the first transpolar flights from Moscow to the United States. One plane landed in Washington and the other in California.

Commercially, an Arctic

air route would revolutionize shipping. Freight and passengers that now move from Europe to the Far East by the Suez or Panama canals, crossing the widest oceans, would have a straight course over the

"top of the world." Flying north between Greenland and Spitzbergen, over the Pole and Bering Strait, planes could bear south to Japan and China, and bring western Europe within a few days of the Far East. Chicago is closer to Denmark via the Arctic.

Aircraft bound for America's west coast could veer east of the Aleutian Islands and reach Seattle or Vancouver in a matter of days. The saving of time, fuel, and costs by this annihilation of distance can scarcely be imagined. Short air routes linking Canada and Russia, Alaska and Norway, Siberia and northwestern Europe, would crisscross the air above the polar sea, until the Arctic coasts became among the most important in the world.

The foremost advocate of these short airways across the Arctic is the explorer, Vilhjalmur Stefansson. He knows the North American polar regions through 11 years spent in his "friendly Arctic," and a series of explorations that tore the veil of mystery from some 100,000 square miles previously unknown. On the

he Byrd party are seen exploring the se which ground and shrieked around

Two members of the Byrd party are seen exploring the fields of pressure ice which ground and shricked around Camp Little America on the Bay of Whales.

Canadian Arctic expedition (1913-18), Stefansson frequently left food supplies behind and set out across the ice to "live on the country" like the Eskimos, finding bountiful nourishment by hunting

RLD ABATELY

sea and land animals. He believes that the calm polar seas, with their ice floes for emergency rafts, make a safer place for a forced landing than the stormy Atlantic.

The military possibilities of polar air travel are being seriously considered. Fast bombing planes with bases in the Arctic could readily reach Canada, Alaska, Siberia, northern Europe, and Japan.

Because of the vast possibilities of these Arctic air routes, the lands over which they pass have

assumed a new importance. Canada claims sovereignty over all lands between her north coast and the Pole, although American and other explorers discovered many of these lands. Russia has occupied Franz Josef Land and renamed it Fridtjof Nansen Land. Here, on Rudolph Island, the Soviet Union in 1935 established the most northerly radio station. Russia also has

tried to colonize Wrangel Island, claimed at various times by England, Canada, and the United States, and maintains a radio station there.

Recent Exploration in the Antarctic

Beginning late in 1928 Antarctic exploration was pushed as never before. An expedition led by Richard E. Byrd, who had flown to the North Pole in 1926, set up a base camp, "Little America," on the Ross Ice Barrier near the Bay of Whales, and spent 14 months in discovery and in geological and meteorological observation. On Nov. 29, 1929, Byrd and three com-

panions flew over the South Pole, making the round trip of 1,600 miles in 19 hours.

Byrd's expedition observed about 220,000 square miles of formerly unknown land, and discovered two mountain ranges, which Byrd called Rockefeller Mountains and Charles V. Bob Mountains. Byrd claimed for the United States a great territory east of the 150th meridian, and named it Marie Byrd Land.

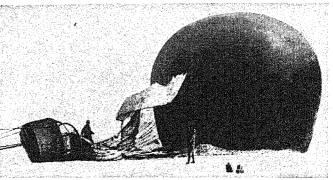
Another Arctic explorer who turned his investigations to Ant-

arctica was Captain Wilkins. His expedition, which established its main base on Deception Island, was under American auspices. In December 1928, piloted by Lieut. Carl Ben Eielson, Wilkins made a 1,200 mile non-stop flight and thought he discovered that Graham Land was a group of islands. In 1929–30 he found that

Charcot Land was an island. (See Wilkins, Sir George Hubert.) Graham Land was proved to be a part of the mainland, however, in 1936. In 1929–30 Sir Douglas Mawson charted some 300 miles of Antarctic coast and claimed Enderby Land for Australia. In 1930 Capt. Hjalmar Riiser-Larsen, flying from a Norwegian exploration ship, discovered Princess Ragnhild Land east of the Weddell Sea and claimed it for Norway.

Admiral Byrd's second expedition, 1933–35, showed strikingly the value of modern methods of exploration.

By sending a seaplane south as his ship drove through pack ice between Hearst Land and Little America. Byrd explored a region that ships had never been able to penetrate. Later airplane flights proved that the Rockefeller plateau was continuous between the Edsel Ford Mountains near the coast and the Queen Maud range near the pole. This proved that no strait



A PHOTOGRAPH WHICH SOLVED A MYSTERY

This photograph of the wreck of Andrée's balloon, which made the first polar air flight, was taken July 14, 1897, on White Island, by a member of the ill-fated party. In August 1930, it was found by Dr. Gunnar Horn, Norwegian explorer, thus revealing what happened.

existed between the Ross Sea and the Weddell Sea. Surveyors working on foot hardly could have accomplished this in a season. Byrd was also the first to study the Antarctic ice cap by seismographic, or "geophysical sounding," methods. Dynamite was exploded and the sound timed till it echoed from the rock or water below. From this interval and the known speed of sound in ice, the thickness could be calculated.

For the first time also, radio was used. This communication with field parties gave added safety and coördination to the expedition. The base also broad-

cast to New York. A third Byrd expedition in 1939–40 opened a remarkable new way of communication by transmitting photographs by radio from Little America to New York. This expedition also used a "snow cruiser," the first automotive vehicle built for polar exploration (see Byrd, Richard Evelyn).

Lieut. Comdr. Lincoln Ellsworth, who earlier had taken part in Arctic discovery, in 1935 forwarded the technique of airplane exploration of Antarctica. His air-

plane, piloted by Herbert Hollick-Kenyon, was the first to make a series of flights independent of a base camp. Ellsworth flew across Antarctica in 13 days, proving it a single land mass. He claimed 300,000 square miles for the United States. On flights in 1939 he made added claims,



A member of the Mawson party swings a pick, meanwhile "leaning" against an Antarctic gale.

BRAVE GUARDIANS of LAW and ORDER

A World without Police! You Can Imagine what It was Like and How Crime Ran Riot—Present-Day Systems of England and America—The Famous Texas Rangers and Canada's Mounted Police

Police. The modern policeman, who seems so necessary to the life of all big cities, did not exist a hundred years or so ago. It is difficult to under-

stand how people could get along without him, and in fact they did not get along very well. In England until 1829 the only peace officer was the constable, who more or less ineffectually patroled the streets at night at the head of a band of assistants called the "watch." The result was that crime was rampant in London and other parts of England. Bands of drunken roisterers terrorized, maltreated, and robbed citizens with impunity. Highwaymen infested the roads: robbers and burglars carried on their work openly. The watchmen were often corrupt and shared the plunder of thieves. It was estimated that in London at the beginning of the 19th century there was a

criminal for every 22 people in the city's population.

This condition continued until 1829, when Sir Robert Peel laid the foundation for a better system. It is true that there had been police systems long

before that time among the nations of continental

Europe, but they were used chiefly as instruments of tyranny. The police (gendarmes) of Louis XIV of France, and later of Napoleon, were examples of this. They spent most of their time prying into political secrets and interfering with the private lives of the citizens, paying little attention to the suppression of

crime. So when Sir Robert Peel proposed his plan he met with strong objections from libertyloving Englishmen who feared the French system. He was able, however, to convince Parliament of the soundness of his scheme, and the foundation of the present British police system was laid. The modern

London policeman is nicknamed a "bobby" or a "peeler," after the founder of the system. (See Peel, Sir Robert.)

The American police system is not far different from the British, except that the American police are usually under the direct control of the city, village, or county. In England they are government agents, holding their appointments under the king, although they are organized and controlled in most respects by the counties and large boroughs.

In the United States the mayor of the city usually appoints the chief of police, sometimes called the commissioner or superintendent. The chief usually has one

or more deputies, who head the various departments. Next in rank are captains, each of whom has a special district of the city under his charge. Some cities have police lieutenants, who work directly under their captains; next are sergeants, detectives, and

finally patrolmen. The three big divisions of the police are the patrol division. the detective division, and the traffic division. Patrolmen are uniformed men who patrol a fixed territory on foot or in squad cars. The detectives who usually rank as sergeants, wear

ordinary citizens' clothing and are assigned to discovering and running down criminals. This branch of the service has charge of the bureau of identification, where finger-



The "mounties," as the Royal Canadian Mounted Police are affectionately called by all Canadians, never give up the chase. No corner of the bleak Arctic and no mountain fastness is too remote for them to reach in pursuit of men who have broken the laws of the Dominion.

That is the reputation of the Texas Rangers, a branch of the state police, whose territory includes the wild borderlands of Mexico.

prints are kept of all who are arrested for grave offenses. (See Finger-Prints.) The duties of the traffic division are to regulate the passage of traffic on crowded streets and to enforce speed regulations. The division often includes mounted officers.

In the rural districts of America the enforcement of the law is left to town constables and marshals and county sheriffs. The latter are usually elected by the people, and have the power in case of emergencies to appoint as many deputies as they may need to maintain order.

A Terror to the "Bad Man"

Some states have a police force of their own, called a state constabulary. The most famous of these are the Texas Rangers. The Rangers have a long and romantic history, extending back to the days when "bad men" and horse thieves and train bandits ran riot in the West. They have established a reputation of always "getting their man," which perhaps is excelled only by the record of the Royal Canadian

Mounted Police. The latter force, which was organized in 1873 as the North West Mounted Police, is one of the most remarkable police organizations in the world. From his offices in Ottawa, the commissioner of the Mounted Police directs the maintenance of order in the more than 1,200,000 square miles of land and water that make up the Northwest Territories. Nearly half of this great wilderness lies inside the Arctic circle. The force consists of 2,500 men, who maintain order not only in this huge territory but in several of the provinces in the Yukon Territory, and in Indian reservations as well. They also perform many services for the Dominion government including the enforcement of Dominion laws, the prevention of smuggling and traffic in noxious drugs, and the protection of government property.

In the United States, the organized militia, or National Guard, of the several states is frequently called upon to assist the police in riots and in great disasters.

such as fires and earthquakes.

and the Policeman Our Young Citizens

F YOU live in even a small village, you probably have a town marshal. He tells boys they must not throw stones or snowballs in the streets, for they

might break windows or hit people-perhaps cause a motorist to lose control of his wheel and crash into another car, bringing death or injury to himself or to others. He tells them not to climb shade trees or fruit trees without the owner's permission, for they might break down limbs. He tells them they must not chase cats or tie tin cans to dogs' tails or rob birds' nests or use sling stones on birds. The law forbids cruelty to helpless animals. You see, all these laws are just good common sense and kindness.

Laws are rules for good behavior. You know how much trouble one selfish illtempered member can make for a whole family. It is the same in school. One unruly pupil can make trouble for a whole room. One boy who is a "bully" on the playground can spoil everybody's fun. Little law-breakers become big lawbreakers when they grow up. Then they find that if they interfere with other people's rights, officers of the law will arrest and punish them. It is better to learn to be good citizens in the home and school, for then it will be easier to obey laws when you grow up.

In small places very few people break laws, because everybody knows everybody else, and a selfish troublesome person soon gets himself disliked and goes away. He is likely to go to a city. He thinks

that where there are so many people he will not be noticed, and he can do as he pleases. But there he finds a whole army of policemen whose business it is

to keep order. Policemen are the friends and protectors of everyone who behaves well, and the enemies of everyone who

makes trouble for others.

Policemen always look out for children. Some school houses in cities are on crowded streets where street-cars, wagons, and automobiles are always passing. Often the children have to cross railroad tracks to get to school. In such dangerous places there is usually a policeman to help the children across. When he lifts his hand, every car or wagon has to stop. Often he picks up a little first-grader who is afraid, and carries her across the street. If a policeman finds a lost child on the street, he summons a patrol and gives the baby a fine ride to the station house. There he is fed and petted and put to sleep. Then the policeman goes to find the baby's mama and papa. A policeman is the best strange friend a little boy and girl can have. You see, he is a peace soldier, and it is his business to take care of people.

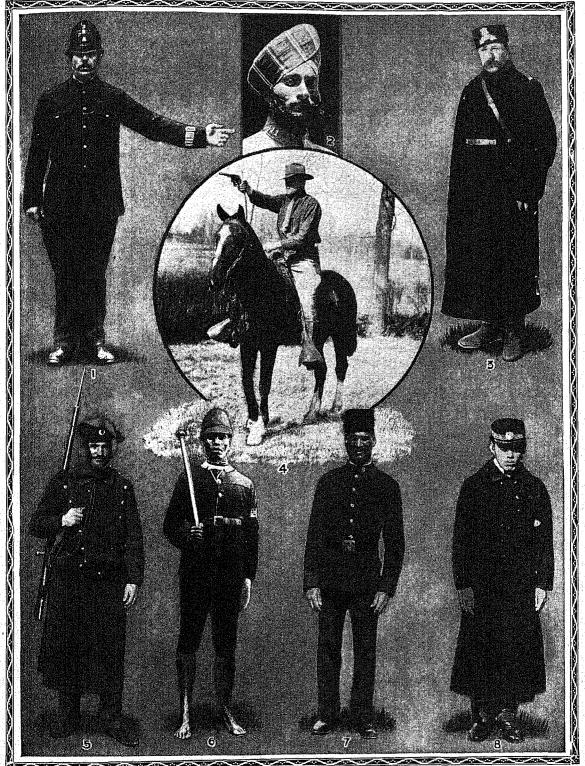
Policemen are often in as great danger as firemen. Sometimes they beat the firemen to a fire. If they do, it is their

duty to go into the burning house and help get They often stop runaway horses, and people out. snatch people from under horses' hoofs and car They dive into park lagoons and into rivers wheels. to save people from drowning. The most dangerous



The upraised hand of the traffic policeman halts traffic in one direction at a busy city crossing, while cars and those on foot move safely across.

THE HAND OF THE LAW IN MANY LANDS

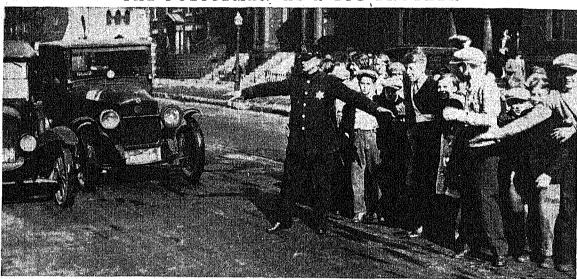


Every corner of the globe now has policemen. Nowhere is the evil-doer safe from the hand of justice, whether he is hiding on the streets of London and New York, in the wilds of central Africa, or the snows of the Yukon. Can you guess from what lands the streets of London and New York, in the wilds of central Africa, or the snows of the Yukon. Can you guess from what lands these policemen have come? We will tell you. 1. A London "bobby." 2. Sikh constable in Shanghai. 3. Officer of the old Russian these policemen have come? We will tell you. 1. A London "bobby." 2. Sikh constable in Shanghai. 3. Officer of the Zulus who imperial police. 4. Member of the New York State Constabulary. 5. Night policeman in Belgrade, Serbia. 6. One of the Zulus who police the Belgian Congo. 7. Native policeman in Cairo, Egypt. 8. Japanese policeman all equipped for a hard winter.

work policemen have to do is to find and arrest criminals. Many of these men, who live by robbing people and breaking into houses, will kill rather than be captured and sent to prison. But policemen will go right into dark basements and alleys, after men who may be waiting for them with pistols and knives. Plain-clothes policemen, or detectives, are in every big crowd watching for pickpockets; and they are often found in dangerous parts of the city where window unlocked. He goes through the place to see if a burglar has broken in. No, he says, you were careless and left that window open. Your father thanks the policeman for watching your house so carefully, and that makes you all the more careful afterward.

A policeman must see that people obey the health and street-cleaning laws. He must stop fights and scatter noisy crowds. He must make people keep

THE POLICEMAN AS A BIG BROTHER



He helps women and children across dangerous street crossings. Especially near public schools, the traffic policeman prevents many an accident by his watchfulness and his willingness to risk his own life to protect others.

criminals try to hide. In such sections, often referred to as the "underworld," detectives spend much time, learning the faces and habits of the criminal classes.

The crossing policemen are among the tallest and strongest on the force. They stand in the middle of street crossings in the crowded parts of the city, guarding people who are afoot, and keeping the streams of wagons; cars, and automobiles from getting in a tangle. Some policemen are mounted on motorcycles. These are in parks and along boulevards, to stop automobiles that are going too fast. There are special policemen who watch railway stations and boat docks, where visitors who do not know city ways are likely to get into trouble. There are always a great number along the line of processions, and at fairs and celebrations.

The Police Patrolman's Duties

The policeman you know the best is the patrolman. Patrol is a soldier word. It means to walk over and guard a district. A police patrolman has several blocks to watch, and he goes over his district several times a day. At night, another man takes his place. The patrolman has to see that no law is broken, and that everyone is protected. Some night, when you are asleep, there may come a ring at the doorbell. A policeman calls up that he has found a basement

things off fire escapes. He must arrest anyone whom he finds abusing a child or an animal. He must take care of persons injured on the street, send them home or to a hospital, and arrest the persons responsible for accidents.

Always answer a policeman's questions and obey his orders. He is an officer of the law and he has a right to stop and question people, and he has a right to your help, if he needs it. Policemen usually watch "gangs," for they know that crowds of boys often do selfish and mischievous things. But don't look upon the policeman as an enemy. Be open and above-board, and don't hide or try to play tricks. Active boys can help a patrolman keep order in his district, for they see everything that is going on. In some cities boys have formed law-and-order clubs, and "traffic squads" to help younger children across streets near schools, and have been given badges to wear by the Chief of Police. Districts that have a band of little citizens helping the police are always cleaner and more orderly, and are shunned by sneak thieves and similar offenders. Boys in such clubs have at times won medals for bravery in fires and for protecting animals that were being abused.

There's a lot of fun in being a little law-and-order

WHAT'S the GOOD of "POLITICS"?

The Origin and Necessity of Parties in the Government of Free Peoples

POLITICAL PARTIES. Ever since men have had popular government, they have had political parties. In ancient Athens democrats and oligarchs clashed over their political principles, and in republican Rome the patricians and plebeians, originally social groups, ultimately struggled for political supremacy. Modern democracies, with thousands or millions of voters, are formed into political parties to secure united action in the selection of candidates who express their views.

Modern Parties Began in England

In England, political parties began with the Whigs and Tories in the days of Charles II. Opposing factions were called odious names: "whiggamore," the Scottish word for horse-thief, and "tory," an Irish outlaw. The Whigs were the parliamentary party, favoring toleration for Protestant dissenters and nonconformists, and holding that the king was only an officer of the government. The Tories supported the established church and the absolute power of the king. Under Sir Robert Walpole, first lord of the treasury from 1721 to 1742, the Whig party organization became firmly established, and the party head was for the first time recognized as the sovereign's leading or "prime" minister. A generation later, two of the leading Whigs, Charles James Fox and Edmund Burke, supported the cause of the American Colonies. Following the Reform Bill of 1832, the Whigs changed their name to "Liberals," and the Tories became the "Conservatives."

Under Disraeli and the Marquis of Salisbury, the Conservatives became the Imperialist party of Great Britain, and after the fusion with Joseph Chamberlain's Unionist wing of the Liberals, they favored a protective tariff. The great Liberal statesman Gladstone won his party to a platform of suffrage extension and home rule for Ireland and the dominions; and under Asquith the party showed sympathy for labor reform. Since the growth of the Labor party after the World War, the Liberals have lost to Labor their position as the "opposition" to the Conservatives. Party organization was practically limited to members of Parliament in England until the second Reform Bill of 1867, when the Conservatives under Disraeli gave the right to vote to masses of workingmen in the cities. Both parties use local clubs as a means of holding voters in the organization, but leadership and policy making remain with the parliamentary members (see Parliament).

"Right," "Center," and "Left"

In other European countries there are usually many parties, sometimes as many as 10 or 15. In some countries there are parties representing social classes—capitalists, agrarians, and laborers; there are also religious and secular parties; monarchical and dictatorial parties opposing democratic, socialistic, and communistic parties; parties of submerged nationali-

ties. Following the practise introduced during the French Revolution, they are classified as the Right, Center, and Left. On the extreme Right are the monarchical and conservative parties, and often the clerical party; in the Center are the agrarians and the liberals, and other democratic parties; on the Left are the radicals, including the socialists and the communists.

Political Parties in the United States

In the American Revolution the colonists who supported the revolutionary movement called themselves Whigs, while those who remained loyal to England were called Tories. Later, the United States was divided on the question of accepting the new Constitution. The Federalists, who favored it, were opposed by the Anti-Federalists, led by Patrick Henry. After the Constitution was adopted, for a few years the new country seemed united in policy. But by 1793, the antagonistic personalities and conflicting ideals of Hamilton and Jefferson, both then in Washington's cabinet, began to divide public opinion into two new factions (see Hamilton, Alexander; Jefferson, Thomas).

Jefferson's followers, the Democratic-Republicans, wore tri-colored hats to show their sympathy with the French revolutionists. They believed in democracy and in the strict construction of the Constitution, and opposed Hamilton's bank as unconstitutional and a usurpation of "states' rights." Hamilton's party, the Federalists, were mostly aristocrats who thought the people incapable of ruling themselves. To launch the new government, they wanted a strong and united federal nation, and they assumed implied powers by a loose construction of the Constitution. In the war between France and England they preferred neutrality, but were accused of favoring England. In 1796, members of the two parties in Congress came together and held caucuses which made nominations for president. The result was a Federalist president, John Adams, and a Democratic-Republican vice-president, Thomas Jefferson.

End of the Federalist Party

Attempting to stem the harsh criticism of the Federalist administration, John Adams signed the Alien and Sedition Acts in 1798, and thus caused the death of his party (see Alien and Sedition Laws). Thomas Jefferson was elected in 1800, but the Federalist judges, especially John Marshall, chief justice of the Supreme Court, continued to give the Federal government more power (see Marshall, John). The Federalists existed as a party in New England until the secret Hartford Convention of 1814, which proposed to limit the powers of Congress and the president, completely discredited them (see War of 1812).

In 1820, the Federalists offered no opposition to the election of James Monroe. In 1824, many "favorite sons" of various states were endorsed by the state legislatures, including Andrew Jackson of Tennessee and Henry Clay of Kentucky. After a contested election in the House of Representatives, John Quincy Adams was chosen president. Accusations of a "corrupt bargain" between Adams and Clay to defeat Jackson rallied many voters around Jackson, and he was elected in 1828. By 1832 another representative of the pioneer West, Henry Clay, had gathered the Anti-Jackson men into a new party, the Whigs. Led by Clay and Daniel Webster, it stood for nationalism, protective tariff, and a national bank. The Jackson group, now known as Democrats, rallied around John C. Calhoun, advocating states' rights, tariff for revenue only, and an independent treasury.

The first national nominating convention was held in 1831 by the Anti-Masons. Other parties followed this example. The first national Democratic convention was called in 1832 by Martin Van Buren, campaign manager for Andrew Jackson. This convention adopted a rule requiring a two-thirds vote to nominate a presidential candidate. The rule prevailed among Democrats until 1936 and often made it necessary to choose a "dark horse" to break a deadlock between two or more strong leaders. The first such dark horse was James K. Polk in 1844. That year, the Democrats applied the "unit rule," by which the majority of each state delegation decided how the delegation's total vote should be cast. But since 1912 Democratic delegates instructed through state preferential primaries are exempt from the unit rule.

The Democratic party remained in power from 1800 to 1840, when the Whigs elected the famous Indian fighter, William Henry Harrison. In the torchlight parades of that campaign, log-cabin floats with barrels of cider for the thirsty and songs about "Tippecance and Tyler too," reminded the frontiersmen that Van Buren lived in luxury, dressed before a mirror, and drank champagne. By this time all men voted everywhere, except in the South, and the men of the West wanted one of their own kind in the White House (see Harrison, William Henry). The leaders of the Whigs doomed their party in 1852 by their compromising stand on the slavery question.

Various minor parties appeared between 1830 and 1860. The Anti-Masons of 1830 opposed secret societies. The American or "Know Nothing" party in 1854 opposed foreign immigration and Roman Catholics, their nickname coming from the reply "I know nothing," when members were asked what their party stood for. Several anti-slavery parties were formed, the Liberty party in 1839, and the Free Soil party, which presented Van Buren as a candidate in 1848. A group of compromisers, trying to avoid the slavery question, formed the Constitutional Union party in 1860, and nominated candidates only for that election.

Growth of the Republican Party

With the repeal of the Missouri Compromise and the passage of the Kansas-Nebraska Act, the North refused to ignore the slavery issue any longer. In 1854, small groups of men gathered at various places, notably Ripon, Wis., and Jackson, Mich., to urge the need of a new party to prevent the extension of slavery. Two years later the Republican party, formed as a result of these meetings, chose John C. Fremont as presidential candidate. In 1860 the Democratic party was split on the slavery issue, and the Republican candidate, Abraham Lincoln, received a majority of the electoral votes, although he had only a minority of the direct vote.

Emerging from the Civil War with great political strength, the Republican party controlled the national government for 70 years, except for the 16 years when presidents Grover Cleveland and Woodrow Wilson represented the Democrats. The Republican party has stood for an increasing extension of federal power and centralization of control in Washington. But in the past few years, opposition to increasing federal power has grown up within the party, as evidenced by its championship of states' rights against the "federalism" of the Democratic "New Deal policies." The party has consistently stood for a high protective tariff. At the end of the World War it opposed the entrance of the United States into the League of Nations, but advocated membership in the World Court. Republicans took the lead in conferences for world disarmament, and voted to ratify the Kellogg-Briand Peace Treaty which aimed at outlawing war.

Delegates to National Convention

The rules of the Republican national convention formerly gave each state two delegates and alternates for every Congressman and Senator the state had in Washington, regardless of party. This gave the South relatively greater representation than the North, as congressional districts in the South usually contain fewer voters than in the North, and because representation from the South in Congress is overwhelmingly Democratic. Further, as most Southern delegates are officeholders, they usually vote as the president desires, so a president is virtually sure of renomination if he wishes it. In 1924, a change was made and now each congressional district has one delegate and an additional one for every 10,000 Republican voters, with three additional delegates if the state went Republican in the previous presidential election. The territories and the District of Columbia also send delegates.

Democratic party policies have been modified to an increasing extent. Below the Mason and Dixon line, the "Solid South" has generally remained Democratic. But the rising industrialism in the South is compelling a change in the old Democratic principle of a "tariff for revenue only," and once in a great while a Southern state has gone Republican.

The presence in both parties of factions that are inclined to depart somewhat radically from traditional policies, has led to the gradual submergence of old political issues. Written to secure the votes of as many citizens as possible, and to offend the least number, party platforms have tended to avoid direct statement of issues and proposed remedies, and to



resemble each other more and more. Single issues do not play the part in United States politics that they do in England, where the defeat of the controlling party on a major issue results in a change of the cabinet or an appeal to the voter in a new election. In the United States organization and party loyalty contribute to maintain the two-party system. Many voters still east a "straight" ballot, regardless of candidates or issues; naturalized citizens usually favor the party which helped them obtain citizenship papers; and officeholders obviously will vote for the party that put them into office, spending time canvassing for the party's candidates. (See Civil Service.)

The abuse of the caucus system led to the adoption of the primary in many states (see Primary Elections). Now precinct committeemen, state central committeemen, and delegates to party conventions are chosen in primaries in many states. In general, party candidates are selected by the organization, but independents have the right to file petitions for a place on the ballot, and the voters make their selection at the polls. At national conventions the presidential candidates are chosen, the party platform is drafted, and the national committee, composed of a member from each state and territory, is selected to carry on the campaign. A friend of the presidential candidate is usually chosen chairman.

Third and Minor Parties

Government works best where parties are evenly divided and public opinion and criticism active. A strong opposition tends to prevent corrupt rule and keep voters alive to their own interests. The two-party system in the United States inclines toward a submergence of issues, and party lines are too sharply drawn in many places on other than straight political

issues. This situation, which often fails to deal directly with live issues, has led to the occasional formation of minor parties. The Mugwumps of 1884. who were dissatisfied Republicans, helped elect Grover Cleveland; the Greenback party of 1876, and the People's party, or Populists, of the agricultural West, in 1890, advocated cheap money. They were finally absorbed by the Democrats, in Bryan's Free Silver campaign of 1896. The Populists were an outgrowth of the Farmers' Alliance, which had combined with the Knights of Labor in 1887 to form the National Farmers' Alliance and Industrial Union. The Farmer-Labor party entered its first national campaign in 1920. Several socialist and communist parties have come into existence (see Labor Parties). Founded in 1869, the Prohibition party eventually helped to secure the adoption of the 18th Amendment. In 1912, the Progressive party was formed, in protest against Republican party convention rules and methods, and with Roosevelt as candidate, polled more votes than the regular Republican party. In 1924, the Progressive party again presented a national platform and a ticket headed by Senator Robert M. La Follette.

No matter how important its issues, a third party cannot at once dominate a political situation. Both major parties work against it, to keep their own ranks mtact, as success can only come through drawing support from both parties. Ordinarily, third parties endeavor to realign citizens on matters at issue, and attempt to break down sectional and other prejudices. Politicians deride them as futile, but they have exerted a reforming influence upon intrenched principles of both parties, and have given voters an opportunity to express themselves on many issues which the major parties have ignored or compromised.

The STUDY of GOVERNMENT in THEORY and PRACTISE

POLITICAL SCIENCE. That branch of the social sciences which deals with the state and the individual's relation to it is called political science. It embraces the theories and principles of government in general (see Government) as well as the practical institutions, laws, and duties of citizenship prevailing in our own or other countries and commonly studied in the schools under the name of "civics."

Theories of government are philosophical in their origin (see Philosophy). In so far as those theories touch upon the duties of a state toward the individual and of the individual toward the state, they may be considered a branch of social ethics (see Ethics). But for the most part modern political science examines the conditions under which various types of government have actually arisen and how they have worked out or are now working out in practise. Governments are often spoken of as "social experiments" and the political scientist endeavors to extract from the results of these experiments rules for future guidance, much as the chemist seeks to derive the laws of his science from results obtained in his laboratory.

So far in the world's history there has been little opportunity for men to build ideal governments based upon rules derived in this fashion. For it has never been possible to start entirely anew. From the day when men first gathered in groups for mutual protection, government has been an absolute necessity that could not await the discovery of guiding principles. Each successive type of government has always been rooted in the one that went before. The course even of a revolution is shaped by the character of the tyranny that preceded it. The unbending dictatorship of Soviet Russia, for example, reflects the harsh autocracy that the Communists overthrew. Progress in government, as history amply reveals, has of necessity been made almost entirely by the method of "trial and error."

One of the first men to write about the state and its relations to its citizens was Aristotle. He may be properly called the "Father of Political Science" (see Aristotle). His views continued to exercise great influence through the Middle Ages. Toward the end of the Renaissance, Machiavelli, the famous Floren-



tine statesman, broke sharply with classical and medieval tradition. He studied not only the life of the ancient Greeks and Romans but also that of his own time, and developed from his studies the principles of modern "practical politics." In the next century Thomas Hobbes and John Locke wrote about political science as a part of their systems of philosophy. Their method was to assume certain principles as axioms, and deduce a theory of government from

these axioms very much as you might demonstrate a theorem in geometry. Montesquieu attempted to explain the course of political development by relating it to physical surroundings, while Rousseau and Kant started with the individual thinking man and worked out theories of the state which would give that man the greatest possible freedom. Others who influenced our thoughts on government were the Comte de Tocqueville, Walter Bagehot, and John Stuart Mill.

-REFERENCE-OUTLINE for Organized Study of POLITICAL SCIENCE—

- I. ORIGIN OF GOVERNMENT: G-125.
- II. FORMS OF GOVERNMENT:
- Monarchy: Autocracy D-45; Limited Monarchy G-126.
- Aristocracy: G-125, D-46, G-157. Oligarchy G-126, F-11, D-45, G-157.
- Democracy: G-125, D-45-9, S-193. Direct Democracy D-48; Free Cities D-46; Representative Democracy, Republic, or Commonwealth D-45, F-178.

Other Political Forms and Doctrines: Feudalism F-27; Socialism S-180; Communism C-324f; Fascism F-17; Dictatorship D-67c, D-47; Anarchism C-325.

Note: A government may be single or unitary, that is, it may consist of a single state in which there is single sovereignty, or it may be federal, consisting of a union of states which have surrendered their right to act independently in matters pertaining to the common interest, while in other respects they have retained complete sovereignty. United States has a federal government, while France, for instance, has a unitary government.

III. CONSTITUTIONS:

- Magna Carta: M-33, G-126, E-271, D-46, C-248.
- B. English Bill of Rights: B-109.
- C. French "Declaration of the Rights of Man": F-202.
- D. United States Constitution: U-206.
- IV. CHIEF OBJECTS OF GOVERNMENT: To Safeguard Liberty G-124; to Preserve Law and Order G-124; to Administer Justice G-124; to Perform Public Works G-124, C-241, U-220.
- V. UNITS OF GOVERNMENT IN THE UNITED STATES:
- A. Town: T-117; Township: T-117; City: C-240-3.
 - -Municipal Government: M-302.
 - Relations Between City and State M-302.
 - Important Departments-Fire Department F-53; Health Department H-254, H-345; Police Department P-287; Police or Municipal Courts C-385; Juvenile Courts J-232.
 - Regulation of Public Utilities P-364.
- The County: C-382. County Clerk C-382; Coroner and His Jury J-230, C-382; Sheriff C-382, J-230, P-288; County Judges and Prosecuting Attorney C-382; County Treasurer C-382.
- The State:
 - a. Relations Between State and Federal Government: States' Rights S-279-80; Powers Given States by Federal Constitution S-279-80, U-208-10; Power of United States Supreme Court over State Laws
 - b. Legislative Department: S-278.
 - Executive Department: The Governor, His Duties and Powers S-278.
 - Judicial Department: Supreme Court C-385: Courts of Appeals C-385; Juvenile Courts J-232.
 - State Constabularies: P-288.
 - Provision for Public Education: S-40, U-259.
 - Control of Corporations: C-371.
 - h. Public Utilities Under State Control: P-364.
- D. The Nation:
 - a. Important Services Rendered by Federal Government: Foreign Relations U-221; Treaties T-129;

Interstate Commerce I-110h, U-231; Foreign Trade I-110d, C-324a; Currency M-196, M-219-22, U-222, J-208; Copyrights and Patents C-362, P-84; Postoffice P-317; National Roads R-112, R-114; Protection of Citizens C-239.

b. Legislative Branch:

- 1. Senate C-332; Vice-President Presides C-334.
- 2. House of Representatives C-332; the Speaker
- 3. Some Specific Powers of Congress C-334; Impeachment (a Judicial Power) I-26, U-220; Regulation of Weights and Measures W-67, U-226-7; Treaty Making T-129, C-332; Making of Bankruptcy Laws B-38; Extraterritorial Powers I-108; Regulation of Immigration I-23-4, U-223; Citizenship and Naturalization Laws C-238-9, A-127, N-27; Duties in Election of President P-343.
- 4. Law Making C-332.
- c. Executive Branch:
 - President—Duties and Powers P-343, V-292, T-129, C-332, U-220.
 - Vice-President V-292.
 - The Cabinet C-3, U-220-1.
 - State Department-Organization and Duties U-221-2; Diplomatic and Consular Service D-70, C-238, U-222; Granting of Passports P-83, C-238, U-221.
 - Treasury Department-Its Branches and Duties U-222-3; Mints and Coinage M-196, M-219, U-222; Bureau of Engraving and Printing M-222, U-223; Coast Guard and Lighthouses C-289, L-123, L-134; Secret Service U-223; Bureau of Narcotics N-12; Taxes, Excises, and Customs Duties U-223, T-16,
 - War and Navy Departments U-223-6; Army A-306; Navy N-50; Marine Corps M-65; West Point M-170; Annapolis N-44.
 - Postoffice Department P-317, U-226.
 - Department of Commerce U-226-8; Bureau of the Census C-129; Patent Office P-84, U-227 picture; Bureau of Standards U-226, W-67; Bureau of Foreign and Domestic Commerce U-227, C-324a; Weather Bureau W-59, U-227; Civil Aeronautics Board A-81.
 - 9. Department of Agriculture U-228-30, A-54; Forest Service F-159, C-342, U-228; the AAA U-230, R-146g; Farm Credit F-12, U-228; Farm Marketing U-230, B-161; Rural Electrification Administration U-228, E-237; Soil Conservation and Land Use U-228, L-61c; Bureau of Agricultural Economics U-228.
 - Department of Labor U-230.
 - Department of the Interior U-230-1; Bureau of Mines M-188-9, U-230; General Land Office L-60; Office of Indian Affairs I-67, A-106, S-40; Bureau of Reclamation U-230, I-149; National Park Service N-19; Fish and Wildlife Service U-230; Geological Survey G-45,

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U-230; Division of Territories and Island Possessions U-231.

12. Department of Justice U-223; Immigration and Naturalization Service U-223, I-23.

Commissions and Boards U-231.
 "New Deal" Agencies U-231-2, R-146g.

d. Judicial Branch: The Judiciary of the United States Government C-385, U-211, M-71; Habeas Corpus H-193; Jury Trials J-229; Prisons P-348.

VI. TAXATION: T-16, I-27, U-223. Tariff T-13. VII. POLITICAL PARTIES AND ELECTIONS:

A. Political Parties: P-291, L-45.

Suffrage: S-318. Woman Suffrage W-131, U-211.

C. Elections: E-213, P-345. Voting by Ballot B-31, C-239, D. Initiative, Referendum, and Recall: I-78.

VIII. CITIZENSHIP, ITS PRIVILEGES AND RESPON-SIBILITIES: C-238-9, A-127, N-27.

IX. INTERNATIONAL LAW: I-108

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B. Arbitration of Disputes: A-246.

C. Extraterritorial Rights of Diplomats: D-71, I-108.

D. Some Rules of War: I-109. Blockade B-157, I-109; Embargo Acts E-258; Privateering and Letters of Marque P-222; Armistice and Truce A-303.

E. Hague Peace Conference: H-195.

F. League of Nations: L-77.

Bibliography for Political Science

-Books for Younger Readers:

Cunningham, A. S., comp. Everything You Want to Know About the Presidents (McClurg, 1941).
Disraeli, Robert. Uncle Sam's Treasury (Little, 1941).

Hartman, Gertrude. Making of a Democracy (Day, 1941). Hughes, R. O. Good Citizenship (Allyn, 1940).

Knapp, G. L. Uncle Sam's Government at Washington (Dodd, 1933).

Leaf, Munro. Fair Play (Stokes, 1939). McFee, I. N. How Our Government Is Run (Crowell, 1938).

Tappan, E. M. Story of Our Constitution (Lothrop, 1940).
Woodburn, J. A. and Moran, T. F. Active Citizenship (Longmans,

-Books for Advanced Students and Teachers:

Allen, F. E. This Constitution of Ours (Putnam, 1940).

Béard, C. A. American Government and Politics (Macmillan, 1939). Ford, G. S., ed. Dictatorship in the Modern World (Univ. of Minnesota Press, 1939).

Greenan, J. T. and Meredith, A. B. Everyday Problems of American Democracy (Houghton, 1940).

Haskin, F. J. American Government (Harper, 1941). Hughes, R. O. Building Citizenship (Allyn, 1941).

Macdonald, A. F. American City Government (Crowell, 1941). Macdonald, A. F. American State Government and Administration

(Crowell, 1940).

Magruder F. A. National Governments and International Relations (Allyn, 1942).

Orth, S. P. Boss and the Machine; A Chronicle of the Politicians and Party Organization (Yale Univ. Press, 1921). Sterne, E. G. We Live to Be Free (Farrar, 1942).

The PRESIDENT Who Won the PACIFIC STATES

POLK, JAMES KNOX (1795-1849). The same Scotch-Irish stock which produced Andrew Jackson, the seventh president of the United States, produced also

James K. Polk, the eleventh president. Polk grew up under much the same frontier conditions as had Jackson, and he was devoted to the principles of "Jacksonian democracy." Like Jackson again, he desired to expand United States territory -a policy which resulted in bringing both Texas and the Oregon territory into the Union during his administration.

His Early Career

Polk's ancestors (then called Pollock) had emigrated from northern Ireland to America early in the 18th century, and his father had been a soldier in the American Revolution. The boy

James was born amid primitive farming conditions in Mecklenburg County, N. C., and obtained such education as that frontier district permitted. He entered the University of North Carolina, at Chapel Hill, at the age of 20; and when he was graduated, in 1818, he was acknowledged to be the best student in his class in mathematics and the classics, and for this reason was chosen to deliver the Latin salutatory address. Two years later he was admitted to the bar, and practised law at Columbia, Tennessee.

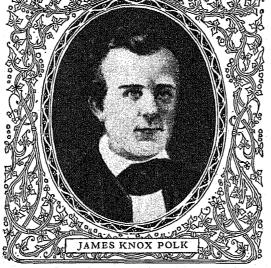
Polk's ability as an orator was called into use in the political as well as the legal field. He was in great demand at political meetings, and he soon earned

the title of "Napoleon of the Stump." During his period of study for the bar he had made the acquaintance of Gen. Andrew Jackson, and this friendship undoubtedly influenced his ideas as well as advanced his fortunes.

Polk's political career began in 1823, when he was chosen a member of the Tennessee legislature. Before his election to the presidency, 21 years later, he had successfully filled the positions of state legislator, had been a representative in Congress for 14 years, filling for four years the difficult post of Speaker of the House when partisan

feeling was exceptionally bitter, and had served two years as governor of Tennessee (1839-40). He was recognized as an able Jacksonian Democrat, and was discussed for the vice-presidency in 1840; but in spite of Jackson's influence in his behalf he was defeated for reëlection as governor in 1841 and again in 1843.

In national politics Polk believed that the government had no right to charter a national bank, or to collect more money from the tariff than was needed to pay the expenses of the government; and he



declared that anti-slavery agitation was a positive evil. Nevertheless, as presiding officer of the House of Representatives, he was fair to those who differed with him. Even the critical John Quincy Adams, the anti-slavery leader of the House, declared that Speaker Polk rendered him "every kindness and courtesy imaginable" during political debates.

It was not on these questions, important though they were, that Polk was elected president, but on that of the expansion of territory. It was understood, before the Democratic National Convention met at Baltimore in 1844, that Polk was a candidate for the nomination for vice-president. Shortly before the Convention met, ex-President Van Buren issued a statement opposing the annexation of Texas. This lost him the nomination and gave it to Polk, with whom was nominated George M. Dallas of Pennsylvania for vice-president. Polk's platform was summed up as

the "Reannexation of Texas and Reoccupation of Oregon," and his determination to thus extend the boundaries both on the southwest and on the northwest brought him the election. The popular campaign cry, especially in the North, was "Fifty-four forty or fight"—thus expressing the determination to take the whole of the Oregon country up to the border of Russian Alaska (54° 40' north latitude) in spite of the counter claims of Great Britain. Polk and Dallas received 170 electoral votes, to 105 cast for Clay and Frelinghuysen, the Whig candidates.

The question of the annexation of Texas was practically settled on the last day of Tyler's administration, when a joint resolution was passed by Congress providing for its admission into the Union. But the work of carrying out this resolution fell to President Polk, and its logical result was war with Mexico. This came about through a dispute between Texas and Mexico over the boundary between the two. Texas claimed the Rio Grande River as its boundary, while Mexico insisted that it was the Nueces River. President Polk agreed with Texas and sent General Taylor to occupy the territory which was in dispute.

Polk and the Mexican War

The Mexican government naturally resented this. After a clash between the troops of the two countries in the disputed territory, President Polk asked Congress to declare war, on the ground that "American blood had been shed on American soil." The North was not as a whole enthusiastic over the annexation of Texas, feeling that it meant an extension of slavery; and when President Polk asked for the declaration of war, many Northern congressmen criticized the

grounds alleged for war. Lincoln, who was then in Congress, introduced a resolution asking that the president point out the spot of "American territory" on which American blood had been shed. In spite of this criticism, Congress supported the Mexican War, which was carried through to a successful conclusion (see Mexican War). The result was to add to the

United States not only the disputed territory between the Nueces and Rio Grande rivers, but also California, Utah, Nevada, and parts of Arizona and New Mexico—more than 522,000 square miles of new territory—in return for a payment to Mexico of \$15,000,000.

This addition of territory raised again in Congress the slavery question. David Wilmot of Pennsylvania moved that, inasmuch as slavery did not exist under Mexican rule, it be specified in the appropriation bill that slavery should not be allowed in any of the territory acquired from Mexico. This

"Wilmot Proviso" was not passed, but it brought sharply to the fore the question of the extension of slavery. The discovery of gold in California in 1848, and the subsequent rush of settlers into that region, rendered the question an important one; but it was left for the next administration to attempt to solve it by the Compromise of 1850.

The Trouble over Oregon

The Oregon question was settled without resort to arms. Though the Democrats had declared that they were in favor of taking all of the Oregon country, to which both England and the United States could advance reasonable claims, they accepted England's suggestion to divide the territory along the 49th parallel, England taking the part to the north and United States that to the south of this line. This was a continuation of the northern boundary of the Louisiana Purchase to Puget Sound. President Polk disliked to accept the suggestion because of his campaign promises; on the other hand he did not care to become involved in war with England; so he left the decision to the Senate, which agreed to accept England's suggestion.

President Polk was consistent in his attitude towards the tariff, the bank, and internal improvements. Believing that the farmer, as well as the manufacturer, was "entitled to the nation's protection," he supported the tariff of 1846, which reduced duties so that they approached more nearly a "revenue" basis. He vetoed two river-and-harbor bills providing for internal improvements at the expense of the national government; and he supported the Independent Treasury Act, which ordered that national funds should be kept in the national treasury.

In 1844 Polk had declared that he would not be a candidate for reelection, and in 1848 he still adhered to that resolution. He was indeed "steadfast to opinions once formed, and not easily moved by popular opinion." He found his greatest happiness in the pleasures of the home circle, rather than in the gay round of public amusements, and looked forward with pleasure to his retirement from public life. But it was a pleasure he enjoyed for only a short time, for he died on June 15, 1849, a little more than three months after he left the White House.

The historian Bancroft, who served in Polk's Cabinet, has left us an estimate of Polk as a "frank and sincere friend, courteous and affable in his demeanor with strangers, generous and benevolent." He adds that "the esteem in which he was held as a man and citizen was quite as high as his official reputation." POLLINATION. The stamens of a flower are covered with fine yellow grains called pollen. For the production of seeds it is necessary for these pollen grains to be transferred to the pistil, the organ in which the seeds are formed. This transfer is called pollination. Sometimes a flower fertilizes its own seedlets with its own pollen, but more often it is the pollen from a male flower growing upon another plant of the same species, and carried by the wind or by insects, which fertilizes the seedlets. (See Flowers.) Polo. This sport, which has sometimes been described as "hockey on horseback," has been justly called the fastest game in the world; it is also one of the oldest games that we play today. No one knows just how long ago it was played or in what country it originated, but there seems to be no doubt that it came from the East. Twelve hundred years ago the Persians were playing it; and the Chinese maintain that their ancestors took part in polo matches a thousand years before Christ was born.

It is an interesting fact that the wild hillmen of the Himalayas play today a rough-and-tumble horseback game that in many ways is like the polo that you will see at a match on one of the beautiful fields in England or in the United States. More polo is played in

India than in any other part of the world. It was brought from that country to England and about 1876 came to the United States.

There are four players on a side, each mounted on a pony that has been trained specially to help its rider. In fact there are many polo ponies that play the game quite as well as their masters do. They follow the ball like a terrier after a rat, and wheel and turn seemingly at the very thought of their masters, who are equipped with mallets to send the ball toward their opponents' goal.

The polo field is a rectangle of turf, 300 yards long and 150 to 200 yards wide, with a goal 8 yards wide at each end marked by posts. The polo stick, which somewhat resembles a croquet mallet, has a long handle and an 8-inch head. Unlike croquet, however, the player hits the polo ball with a full, free swing, and with the flat side, not the end, of the mallet. The ball, which the players try to drive through the goals, is of light wood, painted white. Eight periods of $7\frac{1}{2}$ minutes each make the game, and one point is gained each time a player drives the ball through his opponent's goal.

No game is more thrilling than polo when it is at its best, with eight expert contestants riding like centaurs up and down the field, wheeling and dashing and hitting the ball with almost unbelievable accuracy, and ever trying to send it between the white goal posts.

Water polo resembles basketball more than it does polo, for the members of the teams play "free handed," without any stick or implement in their hands. The game is played either in open water or in an indoor swimming pool. The playing area is usually between 50 and 100 feet long by 20 to 60 feet wide. At either end there is a goal six to ten feet wide, with a cross-bar three feet above the surface of the water. Six or more players make up a team, and the object of the game is to throw an inflated ball, about eight inches in diameter, through the goal beneath the cross-bar. Usually there are four periods of five minutes each.

AN EXCITING MOMENT IN A GREAT GAME



One of the teams in this photograph is American; the other is English. They are playing for the Polo championship of the world. These two nations have brought to its highest development a game played by the ancient Persians at least 2,000 years ago. Horses for the game are now not merely trained, but specially bred, for the game requires an animal with "the power of a hunter, the courage or a racehorse, and the docility of a pony."

Polo, Marco (about 1254-1324). One day in the year 1295, three bearded and travel-stained men appeared in the Italian city of Venice. They were strange figures among the gayly clad Venetians, for they were dressed in worn garments of curious and outlandish cut. So strange did they look that when they announced that they were Messrs. Nicolo and Maffeo Polo, with Nicolo's son, Marco, and that they were just returned from 20 years' absence in Cathay, even their own kinsmen could hardly believe that these were really the men whom they had thought dead these many years.

The newcomers caused a great feast to be prepared, to which they invited the principal citizens of the town. At the feast they appeared successively in three wonderful changes of silken raiment, each of which when it had been worn for a few moments they ordered cut up and divided among the servants.

While the guests marveled at this, Marco Polo brought out the three soiled coats of quilted cotton which they had worn upon their arrival home. With a sharp knife he cut open the seams, and from these hiding places he poured out handfuls of precious stones—rubies, sapphires, diamonds, and other gems, cut and uncut-of enormous value. This wealth they had acquired at the court of the great Kublai Khan, Emperor of China or Cathay, and they had brought it in this form, knowing that they could not carry so large a sum in gold. The doubting Venetians were thoroughly convinced as to the identity of the travelers, and thereafter the Polos were treated with the respect which they deserved.

The Story of His Adventures

Soon after their return Marco, the youngest, was captured in a sea battle between Venice and Genoa and carried off a captive to the rival city. While in prison there he fell in with a certain Rusticiano of Pisa, a writing man, to whom Marco dictated his adventures. So it happened that we have 'The Book of Ser Marco Polo', one of the strangest and most interesting records of true adventures ever written.

The story told in the book is this. Nicolo and Maffeo Polo-Marco was then a baby-went on a trading speculation to the Crimea, and thence, one thing leading to another, on to Bokhara in Turkestan. There they met some envoys from the court of Kublai Khan, the great Mongol emperor who ruled over most of Asia. With these envoys they journeyed to China, which the Khan had conquered in 1267, and were there received with much favor. The Khan had never met any Europeans before and was much interested in what they had to tell him. After a time he determined to send them back to Europe as his envoys to the pope, asking that 100 missionary teachers be sent to instruct his people in Christianity and the arts of Europe.

So the Polo brothers had returned home to Venice in the year 1269, where Nicolo found that his wife was dead and his son Marco 15 years old. After many delays they succeeded in giving Kublai's message to the pope, who was however not able to do much for him. They then set out again for China (1271) taking with them the young Marco.

When they arrived at the court of Peking, the Grand Khan Kublai, who was now an old man but one of great ability, took a great fancy to young Marco, and made him a sort of minister extraordinary, sending him on many journeys throughout all his empire. He learned to speak and read several Asiatic languages, and even visited Tibet and Burma. During these travels Marco collected much interesting information concerning the strange places and people he saw, and it is this information which is written in his book. He also served for three years as governor of the city of Hangchow.

The Famous Trip with the Princess

This time the Polos dwelt in Cathay for about 20 years. Many times they wished to return to Venice, but Kublai Khan would not hear of it. If it had not been for a fortunate chance they might never have returned, and the world would never have heard their story. When at last they were given permission to depart, it was to accompany a young princess who was destined as the bride of the Khan's grandson in Persia. Kublai equipped them magnificently and gave them messages for all the rulers of Europe. Thus, early in 1292, they finally left China.

The trip to Persia was made by sea, and the Polos were the first of Europeans to sail those seas. On account of storms and other mishaps the trip occupied two years. Many of the party died by the way, but the three Polos and the young lady survived. When they arrived at their destination they found that the destined bridegroom was dead, but the lady was married to his son. The Polos then returned to Venice, arriving as has been described. Marco lived to be over 70 years old, and died at home, highly

honored by the Venetians.

Marco Polo was thus the first traveler to trace a route across the whole breadth of Asia and to describe Persia, the Mongolian steppes, China and India, Japan and Ceylon, Java and Sumatra, and many other places, as things seen with his own eyes. If these travels of his had been taken at their full value by the Middle Ages, the science of geography would have been very much advanced. But unfortunately they were looked upon by most people rather as fairy tales, though they had their influence, no doubt, in leading Columbus to seek this land of Cathay by sailing westward. It has taken the knowledge gained in later times to show how scrupulously true and how valuable Marco Polo's book really is.

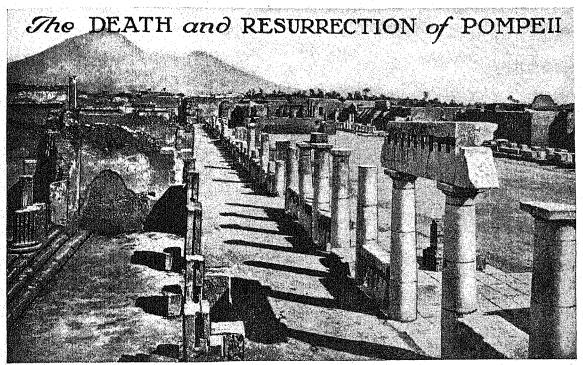
POMEGRANATE (pŏm'grăn-at). Owing to the fact that the lemon and orange were unknown in early Europe, the acid of this orange-shaped fruit was especially grateful to the ancient Greeks and Romans. From the days of the ancient Assyrians and Egyptians, also, the pomegranate has been a symbol of beauty. Its large brilliant scarlet flowers and its reddish-golden fruit, growing out of the axils of its shining green leaves, have inspired countless allusions in literature and representations in ancient sculpture. The Bible contains many references to it, and in the 'Odyssey' the cultivation of the pomegranate is described in the gardens of the mythical kings of Phaeacia. According to the Greek legend Persephone had to spend six months of each year in the underworld, because she had eaten six seeds of the pomegranate while living with Pluto. (See Demeter.)

The pomegranate is little used today as an article of food, for the palatable pulp is merely a coating for the innumerable seeds. It is still in favor in Mexico and Persia, however, in the making of beverages. From the leathery rind of the fruit, from the bark

of the tree, and from the root, tannin is extracted for use as an astringent in medicine and in tanning leather.

The pomegranate grows wild in Afghanistan, northwestern India, and southwest of the Caspian Sea, and is widely cultivated throughout the tropics and subtropics. In the United States it is cultivated commercially only in a few Southern states, but is used as a hedge over a wider latitude. The native tree is small and bushlike, with opposite or alternate lance-shaped leaves. Under cultivation it reaches a height of between 15 and 25 feet.

Scientific name, Punica granatum (Punicus meaning Carthaginian, because it was imported by the Romans from Carthage). Some botanists ally it to the myrtles; others place it in a separate family Punicaceae.



A View of the Ruins of Pompeii, after the Ashes and Soil of Centuries Had Been Removed

Pompeii (pŏm-pā'yē), Italy. For 600 years the ancient city of Pompeii had nestled on its plateau of ancient lava, on the Bay of Naples, less than a mile from the foot of Mount Vesuvius. It carried on a prosperous trade in wine and oil, and many wealthy Romans had built villas there, lured by its blue skies and the glamor of Greek elegance it had kept from early times. Within the memory of man the mountain had always been friendly, and the lava poured out in ancient eruptions made a good soil for grapes and furnished stone for pavements and buildings.

Then, on the morning of August 24, in the year 79 A.D., the giant volcano suddenly awoke from its centuries of slumber and began belching forth a great column of cinders, pumice stone, and ashes. A dense black cloud shot up to an enormous height and over-

spread the heavens. It blew rapidly toward Pompeii, shrouding the city in darkness, broken only by lightning flashes, and there descended upon the doomed city a hail of pumice and volcanic ash. For three days the terrible rain of fire continued. Most of the population escaped, but some of those who sought to flee in boats had those sink beneath them under the weight of the ash. Others who sought refuge in cellars were suffocated by the stifling sulphur fumes or crushed under falling roofs. About 2,000 persons perished out of a population of 20,000. At each of the eight gates, the sentries, true to the stern Roman ideal of duty, died at their posts, and there their remains have been found embedded in the ash. When the darkness lifted on the third day Pompeii lay buried under eight to ten feet of pumice, and six

A POMPEIAN MATRON SPENDS AN AFTERNOON AT HOME



The Pompeians did not overwork themselves, as you might guess from this painting. Not all Pompeian mothers, of course, could afford to have slaves swing them all the afternoon, while their children played around them. But luxury was the prevailing note, for Pompeii was a favorite resort for wealthy Romans.

or seven feet of volcanic ash. So great was the alteration of the seacoast that the site now lies nearly two miles inland.

Under this blanket of death the city remained buried and gradually forgotten for nearly 1,700 years. In 1748 a peasant came across traces of it beneath his vineyards. Since then the city has been gradually dug out, bit by bit, until now its ruins tell us the story of Roman everyday life as it is told nowhere else. Here you may walk between rows of shops and houses, along street after street with the marks of the horses' hoofs and the ruts worn by chariot wheels in the paving blocks. You may also read on the walls the scribblings of schoolboys, announcements of shops to rent or gladiatorial contests, and election notices scrawled in flaming red letters.

Public life as shown by excavations centered in the forum or market place, where temples elbow business houses and offices. In the market stalls edging the forum were found charred nuts, fruits, and loaves of bread, left by the dealers in their flight; and a wall painting shows how peddlers of kitchen utensils and shoemakers used to ply their trades in the forum itself.

A short distance from the forum is a cluster of temples, and with them a great open-air theater.

Not far away is a smaller roofed theater, the palaestra, where young men wrestled and threw the discus, and the barracks of the gladiators. Here were found greaves and helmets and gladiatorial swords. Three public baths lie convenient to the forum and the palaestra. These are so well preserved as to show the way great furnaces were used to heat the water and supply hot-air heat for the rooms, and how the bather proceeded from a warming room to a hot room, then to a cold room, and outdoors again.

Home Life in Pompeii

Of private life in ancient Pompeii the story is equally complete. The houses show a blank wall to the street, as oriental houses and many in southern Europe still do. Once you enter the vestibule you see that the occupants got their air and sunlight from a central court or a back garden. Opening out of the great room or atrium are the bedrooms—hardly more than cupboards—the store room, dining room, and kitchen. In the kitchen is a raised hearth, on top of which burned the charcoal fire for cooking; in houses where there was a bath this hearth was made to provide heat for that as well. A water system brought water for the bath and sometimes for a fountain in the atrium as well. The only thing you miss is furniture, for of course the wooden beds and chairs

THE CHEERFUL HOMES OF THOSE OLD DAYS



This is a reconstruction of a house found among the ruins of Pompeii—the house of Pansa, it is called. Although it was the home of a Roman gentleman when the ashes of Vesuvius buried it in 79 A. D., it is one of the best examples we have of a Greek house, for the Romans borrowed their plans from the Greeks, and made only a few changes in style, such as the rounded arch of the doorway.

and dining couches were all burned or have since crumbled away, leaving only the wall paintings and the mosaic floors as decorations for the interiors.

We see also in this uncovered city how people worked as well as how they lived. Outside the bakeries are the great millstones which ground the grain and inside you will sometimes find kneading apparatus. A potter's workshop has two ovens; the dyehouses are provided with large lead kettles, and in a closet were found bottles containing colors; the tannery has vats and tools of bronze and iron. There are inns and wineshops, with utensils for heating food and drink and great stone jars set in the counter for storing them.

One or two street signs remain, in terra cotta relief, and the books of an to 120 feet of hard rocklike lava, but tunnels have auctioneer's establishment were found—waxed tablets with receipts scratched on them.

Many thousands of smaller objects found in Pompeii have been taken to the museum at Naples, 13 miles away, for safekeeping. There you may see

paintings, statues, mirrors, coins, pens and ink bottles, and even the very food that some of the Pompeians were having for lunch on the day of the eruption, and the pans it was cooked in. In the smaller museum at Pompeii are death casts of some of the people themselves, for the ash that buried them formed a sort of plaster mold which has preserved the outline of their bodies.

A few miles nearer Vesuvius lies Herculaneum, another Roman city buried in the same eruption. Excavation is much more difficult here, since the city is covered by 30

The ashes that buried Pompeli formed a sort of plaster mold which preserved the outlines of this dog's body, centuries after the body itself had moldered into dust,

been sunk to the great theater, the forum, and some temples and private houses. Though the ruins are much less accessible and interesting to visit than those of Pompeii, the art treasures unearthed—statues in marble and bronze, and paintings—are far more valuable. The most remarkable discovery was that of 1,800 rolls of papyrus manuscript, charred almost to einder; but hundreds of these manuscripts have been unrolled and deciphered.

POM'PEY THE GREAT (106-48 B.C.). In the stormy times that marked the close of the Roman republic, Gnaeus Pompeius, who was born in the same year as the orator Cicero and six years before the illustrious Julius Caesar, was one of the most celebrated of Rome's military leaders. In the civil war between Marius and Sulla he won such a brilliant victory over the Marian armies, in Africa and Sicily, that on his return to Rome he received the title Magnus, or "The Great." After a successful campaign in Spain he was elected consul for the year 70 B.C., and although he was under the legal age, and had held none of the lower offices, the Senate reluctantly removed these disabilities by a special act. He espoused the people's cause, and repealed many of the hated laws of the aristocrat Sulla, passed after his victory over the followers of Marius.

After the close of Pompey's consulship he was given supreme command in the Mediterranean and for 50 miles back from its shores—an unheard-of power. He rid the Mediterranean of the pirates who had long infested it; he subdued Mithradates, ruler of the kingdom of Pontus on the shores of the Black Sea, and Tigranes, king of Armenia; and captured Jerusalem and made Syria a Roman province. When he returned to Rome for his third and most splendid "triumph," he was looked upon as a second Alexander.

This triumph marked the turning point in his career, for in political affairs he proved less able than in military. An alliance, known as the first triumvirate, was formed between Pompey, Crassus, and Julius Caesar, and Caesar gave his daughter Julia in marriage to Pompey. But after her death, and that of Crassus, the bond between Caesar and Pompey was loosened, and jealousies arose. While Caesar was ruling the province of Gaul as proconsul and gaining great prestige, Pompey remained at Rome, where he gradually lost influence.

Fearful of Caesar's power, he now returned to the Senate party. The inevitable conflict came when Caesar, refusing to disband his army at the command of the Senate, crossed the Rubicon and marched to Rome. This civil war ended with a complete victory for Caesar at the battle of Pharsalus, in Thessaly, in 48 B.C. Pompey fled to Egypt, where he was treacherously murdered.

PONCE DE LEON (pōn'thā dā lā'ōn), Juan (about 1460-1521). It was an old legend that made a discoverer out of this Spanish soldier of fortune. Perhaps while he was accompanying Columbus on his second voyage (1493), perhaps later while governor of Puerto Rico, Ponce de Leon heard from the Indians of a mysterious island called Bimini. In this was a

wonderful healing spring. Old men, bathing in it, became young again. In 1513 Ponce de Leon sailed in search of Bimini and the "Fountain of Youth." He sighted land on Easter Sunday, and a few days later landed in Florida near the mouth of the St. Johns River. He explored the coast southward to the tip of the peninsula, and then the west coast north to Pensacola Bay. On the return voyage to Puerto Rico he discovered the Bahama Channel, which later became famous as the homeward route of Spanish treasure ships from the West Indies. In 1521 Ponce de Leon revisited Florida and was fatally wounded in a battle with the Indians. He is buried in the Cathedral at San Juan, Puerto Rico. (See also Florida.)

POOR RELIEF. No society is so simple that it does not contain some members unable to take care of themselves; and no society is so hard-hearted that it is unwilling to take care of some of its dependents. Orphans, the aged, the blind, the crippled, the feeble-minded, and the insane have always been dependent upon others. Athens supported at state expense those who had been wounded in battle and the widows and orphans of those who had fallen. In ancient Rome, Gaius Gracchus introduced the free distribution of grain to the poor classes, and under the Empire some 200,000 were thus fed by the state.

Christianity laid great stress on alms-giving as a religious duty. In the Middle Ages, the Church was the great receiver and dispenser of alms. In England, after the revenues of the Church had been diminished by the Reformation, the state began to take over responsibility for poor relief. In 1601 the Elizabethan Poor Law provided that each parish should collect a tax for relief of the destitute. This system remained in force until 1834, when a new law provided for national control.

At first there was no distinction among types of sufferers needing care. Thus a medieval poorhouse or church refuge contained all kinds of unfortunates lumped together. Today we have special agencies to take care of each type of misfortune in the proper way; and we limit our "poor relief" to those who are unable at the time to make a living, though they are not physically or mentally handicapped.

For the poor we have three kinds of care: private charity, social insurance, and poor relief. Private charities are limited by the amount of money they receive and by the fact that in times of depression, when needs are greatest, contributions drop sharply. Social insurance is possible only where the future cost can be predicted, as for sickness, old age, and temporary unemployment. Poverty from other causes must be cared for by some form of poor relief.

For many years, relief in the United States was solely a local responsibility. Counties, townships, and the larger cities cared for their needy under widely varying state laws. This aid was chiefly "in" relief, that is, food and lodging in poorhouses and other institutions. Some "out" or "home" relief, that is, allowances to persons living at home, was given;

but this was done largely by private charitable societies, often organized into "community funds."

But the national depression forced many states to take over relief in 1931, and in 1933 the Federal government assumed supervision of all relief under the Federal Emergency Relief Administration, granting home relief money (see Roosevelt, Franklin D.). In 1935 home relief was returned to the states, which now supervise and aid local systems.

Federal relief for the unemployed is confined to unemployment insurance and to "work relief" in the Work Projects Administration, the Civilian Conservation Corps, and the National Youth Administration. Though it is costlier than home aid, work relief is defended on the ground that it improves communities and preserves the morale of workers. Relief for unemployables consists of grants to states for care of the aged, the blind, and dependent children (see also Pensions; Philanthropy and Charities; Social Insurance). POPE, ALEXANDER (1688-1744). Few men have triumphed over greater handicaps than did Pope, who became the foremost poet of his day. He was sickly and had a deformed spine; and the intolerance of that day closed the better schools to him because he was a Roman Catholic. But from his earliest youth, according to his own words, verse came to him with little effort. He said that as a child he "lisped in numbers for the numbers came." The "numbers" took the form of the heroic couplet, which was then the prevailing verse form. The following is an example:

Know then thyself, presume not God to scan; The proper study of mankind is man.

The first long poem which Pope published was the 'Essay on Criticism'. In it he expressed the commonsense ideas of his time on art in literature, in the most compact and highly polished form yet seen in English. The 'Essay on Criticism' made a name for him in 1711, the year of its publication. In 1712 appeared 'The Rape of the Lock', which tells in mock heroic style of the theft of a lock of hair from a belle of his own day. Pope added sarcasm to his verse in such lines as:

Not louder shricks to pitying Heav'n are east, When husbands or when lap-dogs breathe their last.

By this time Pope was famous. He was known to all literary men of London and formed friendships with many of them. Swift the satirist and Lord Bolingbroke the statesman were his favorites. During the ten years following he was busy with his translation of Homer into English verse; this is still the most popular and most generally read translation, though its style, in the words of Matthew Arnold, is "entirely alien to the plain naturalness of Homer's manner."

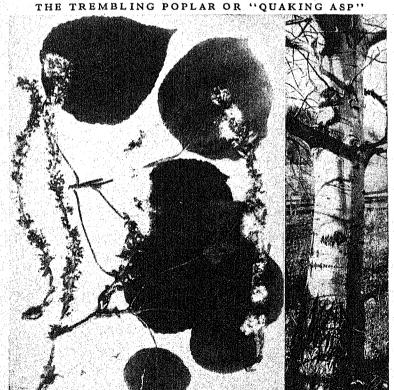
Crooked and dwarfed in body, Pope was also crooked and dwarfed in spirit. In 'The Dunciad' he

heaped ridicule and abuse upon his enemies and critics in a manner wholly disgusting to modern taste. He excused himself on the plea that less vigor would have no effect. In his own words he says: You think this cruel? Take it for a rule, No creature smarts so little as a fool.

All Pope's work shows his mastery of epigram, of tightly packed wisdom; but his 'Essay on Man' is more quoted than any other, partly because quotable couplets occur in greater profusion in it, and partly because it is the best expression of the philosophy of life which prevailed so widely in Pope's day: "Whatever is, is right." Today no one ranks Pope as a great poet, but he is assured the immortality that comes to one who can make commonplaces quotable in a form half poetic, half philosophic.

Pope's chief works are: 'Essay on Criticism' (1711); 'Rape of the Lock' (1712); Translations of the 'Iliad' and the 'Odyssey', 'The Dunciad' (1728); 'Essay on Man' (1734).

POPLAR. There are about 25 species of this tree native to the Northern Hemisphere, about half



All varieties of Poplar grow very rapidly, and are valuable for shade and ornament years before the slower-growing hardwood trees have become useful. Here we see the bark, leaves, and "catkins" of the Trembling Poplar.

of them belonging to North America. They may be divided into two groups, the balsam poplars, having sticky buds, and the white poplars and so-called "aspens," whose buds are not coated with resin. Clothed in trim garments of fluttering shimmering silver and green leaves, among which are hidden fluffy drooping catkins, the common poplar or cottonwood (Populus deltoides) abounds along the roadsides and in the fields. The leaves appear early in the spring and in the first part of June the tiny seeds begin to fall from the feathery catkins, covering. the ground with the soft delicate cotton in which they are inclosed. Through the summer the abundant heart-shaped foliage casts a cooling shade. The tree is highly valued for ornamental purposes, but the wood is soft and is of little value excepting for paper pulp. The aspen types with tremulous foliage include a few "weeping" forms which are exceptionally beautiful. The balsam poplars (the tacamahac and the Balm-of-Gilead poplar) flourish in Canada, Alaska, and the northern parts of the United States.

The tall spire-shaped Lombardy poplar is a distinctive feature of the landscape in many parts of Europe and North America. Probably no tree introduced from abroad has been more widely planted in the United States. Landscape architects love the contrast af-

forded by its skyward-pointing lines.

The great tulip tree (Liriodendron tulipifera), which is one of the finest American forest trees, is not a true poplar, though often called the "tulip poplar." **POPPY.** What the tulip is to early spring, the poppy is to midsummer—a gorgeous riot of color flaming in our gardens, with blossoms equaling in beauty and variety of form those of its earlier blooming rival. Its nodding buds, the dainty poise of the opened flowers, and the silken texture of its brilliant petals make it one of our leveliest blossoms. In addition to the single kinds-ranging through an infinite variety of color, from pure white, pink, and rose, to yellow, orange, and scarlet—there are the plumelike carnation-flowered poppies with fringed petals, and the double peony-flowered varieties with plain rounding petals which rival their namesake in size and gorgeousness of coloring.

These garden varieties of the poppy have all been obtained by selection and cross-breeding from different wild varieties, of which perhaps the ancestor of the opium poppy (Papaver somniferum) is the chief. The latter is probably a native of southern Europe and western Asia, but in Persia, India, and China it has been extensively cultivated to produce the opium of commerce. Its milky juice, thickening and darkening as it issues from shallow cuts made in the young capsules, furnishes the crude opium (see Opium). The seeds yield oil used in making paint

and cheaper grades of salad oil.

The common scarlet or corn poppy (Papaver rhaeas) which grows wild in the wheat fields of Great Britain and the European continent, is another parent of the garden varieties. This is the poppy so often men-

tioned in English literature. Ruskin describes it as "all silk and flame, a scarlet cup seen among the wild grass, far away like a burning coal fallen from Heaven's altars." In the World War this European poppy took on a more poignant significance, for—

In Flanders' fields, the poppies grow Between the crosses, row on row, That mark our place; and in the sky The larks, still bravely singing, fly, Scarce heard amid the guns below.

We are the dead. Short days ago
We lived, felt dawn, saw sunset glow,
Loved and were loved; and now we lie
In Flanders' fields.

The little yellow poppy which grows wild through the Middle West of America belongs to a different genus (Stylophorum) from the Old World poppies. Of still another genus is the California poppy (Eschscholtzia californica) from which Luther Burbank has developed with his wizard skill beautiful cultivated varieties of many shades.

POPULATION. Man has inhabited the earth many thousands of years, but his numbers have increased more in the last four generations than in all the uncounted generations before. No reliable figures exist for world population in the year 1800, but we know that it must have been far short of a billion (perhaps 700 or 800 millions). Today it is reckoned at more than two billions.

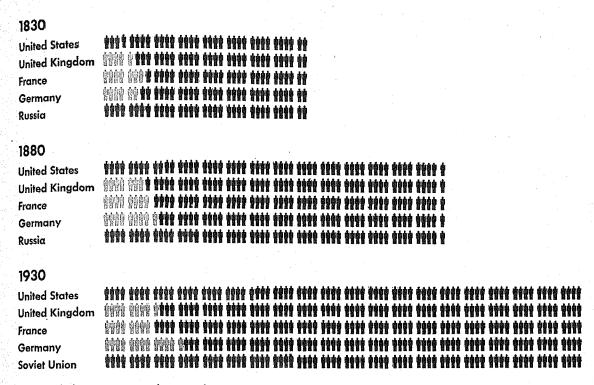
The primary cause of this increase is the advance in science in the last century and a half. Improved agriculture and stockbreeding have increased the world's food supply. The use of power machines has multiplied a hundredfold the product of man's labor (see Industrial Revolution). Railroads and steamships have opened up new agricultural and manufacturing regions and have thus helped to increase the supply of goods available to support a rapidly growing population. Medical science has reduced the death rate by its achievements in preventing and curing disease. The annual death rate in the British Isles, for example, fell in 50 years from 23.7 for each thousand of the population to 17.5—a decrease of almost one-fourth. Thus more people live to old age than formerly, and the average limits of life have been extended.

In many countries, however, population growth is now slowing down—notably in northwestern Europe and the United States. The chief factor in this decline in growth is a decrease in the number of births for each thousand of the population. This fall in the birth rate is the result in part of social and economic conditions that make it difficult to provide adequately for large families of children under the high standard of living in the more progressive nations.

Population Changes in the United States

Growth of population in the United States has been slowed down, not only by an almost steady decrease in birth rate since the Civil War, but also by drastic restrictions on immigration since 1921 (see Immigration). If present trends continue, the United States may cease to grow in population as early as 1955 and probably

Growth of World Population 1830-1930

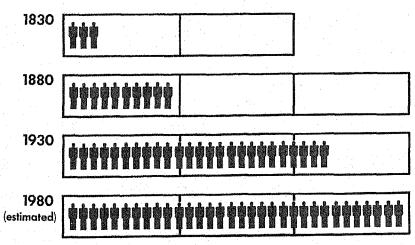


Each symbol represents 5 million population

Each full row of symbols represents one-fifth of the population of the World for the year indicated black: rest of the World

United Kingdom 1930: excluding Irish Free State

Population and Area of the United States



Each symbol represents 5 million population Each rectangle represents 1 million square miles

Prepared for Compton's Pictured Encyclopedia International Foundation for Visual Education

World population more than doubled between 1830 and 1930, with the United States and Russia growing faster than the United Kingdom, France, or Germany. Between 1830 and 1880 the United States more than tripled its population, while gaining about 50 per cent in area, as shown in the lower pictograph. In the next 50 years the population more than doubled itself. But in the present half-century, from 1930 to 1980, it is expected to increase by less than one-third.

not later than 1980, according Birth and Death Rates in 1935 to estimates of the National Resources Committee. Thereafter, it is predicted, the population will actually become

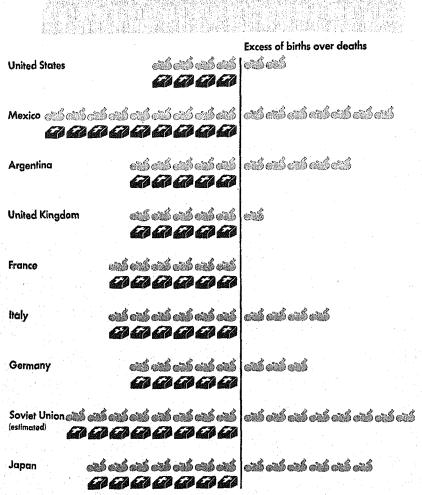
With relatively fewer births. but with more people living to old age, the United States is becoming a nation of adults, with an increasing proportion in the middle- and upper-age groups. In 1900 there were 90 people under 20 years old for every 100 between the ages of 20 and 60. Today there are fewer than 68 people under 20 years old for every 100 in the older group. Since 1820 the average age of the population has risen from 17 to 27 years.

This shift in the age distribution of the population has given rise to serious economic problems. The number of productive workers is increasing at a much slower rate than the number of aged people. This means that the workers may have to bear a relatively heavier burden of taxes to supply pensions for the aged who have no jobs and to provide medical care for the many who become ill in body or mind. A more cheerful side of the picture, however, is the fact that more of the country's resources (such as timber, minerals, and food) will be available for each person than if the population were increasing its rate of growth.

Business faces a new distribution of customers. Many businesses catering to the young will shrink; those catering to the upper-age

groups may expect an increase in trade.

The changing distribution of age groups gives the educational system new opportunities for service. A relatively smaller number of children may mean that school classes will be smaller and that each child will receive longer periods of individual instruction from the teacher. Again, a nationwide system of adult education may be used to retrain older people for jobs that demand new technical skills and to help them adjust themselves to changing conditions. Adult education may also serve to keep older people mentally vigorous by enriching their lives with interests that will make their later years happy and profitable.



Each red symbol represents 25 births per 10,000 population Each black symbol represents 25 deaths per 10,000 population

Prepared for Compton's Pictured Encyclopedia International Foundation for Visual Education

Which are the most rapidly growing countries? If we neglect migration from one country to another, the answer is found in the excess of births over deaths in each country. This pictograph shows us that the Soviet Union, Mexico, Japan, and Argentina are growing more rapidly than the other countries represented. The United States is growing faster than the United Kingdom because it has a lower death rate, but not so fast as Italy and Germany. France is almost stationary. (Data from 'Statistical Year-Book of the League of Nations'.)

More than half of all the people in the world live in Asia. One-fourth live in Europe. Though Asia still shows remarkable powers of growth, the increase in population over a long period of years has been greatest in the Western world, where science chiefly flourishes. Contrary to a general belief. Europe has on the average twice as many people to the square mile as has Asia. England, with an average of 742 to the square mile, is almost as crowded as Java, the most thickly settled land of the Orient. But we must remember that England's population is chiefly industrial and derives its food largely from other countries, while Java is almost entirely self-supporting, as is the rest of Asia.

20°N 20°S ပိ (W 80 3) CONCENTRATED 160°E ARE NUMBER OF INHABITANTS TO THE SQUARE MILE LESS THAN 5 57025 PEOPLE 40°E More THAN 250 CIRCLE WORLD'S 50 To 250 25 To 50 40°₩ THE OF WHERE MOST CAPRICORN CANCE EQUATOR Ö TROPIC TROPIC OF (EOM W) 2005 20°N 40°% °

This map of the world shows in broad outline where the great masses of mankind live. A single glance shows that a large portion of the earli's people dwell in a few crowdded areas, shown here in solid black. At the other extreme are the regions (shown in solid gray) where there are less than froe persons to the square mile. Included in this classification are wast arctic and desert areas where there are no people at all, except perhaps in small or temporary settlements. The controlling factors in the distribution of human beings over the earlie are dimate and the nature of the land. The densest populations are been counting two kinds of places. First are the areas, like eastern China, infina, and Java, having a mild or a tropical climate with ample rainfall and a good basic soil constantly enriched by deposits washed down from surrounding hills or mountains. Under

these conditions the food supply is large and people from less favored areas gather there and multiply. The rainless valley of the Nile illustrates a variation from the usual conditions, since here the river itself through its annual floods brings both natural irrigation and soil enrichment. The second type of densely populated regions are those with unusual advantages for manufacturing and trade. Usually, as in central Europe, in parts of England, and in the great metropolitan areas of the United States, the surrounding lands provide a considerable part of the food supply of the crowded area. But the essential geographic factors are stimulating climate and the chance to develop raw materials and transportation. The former generates energetic industrial life; and the latter the traffic in raw materials and finished products that brings the wealth to feed and house a large population.

How many people belong to each of the large racial groups no one can say. Accurate figures do not exist. But population authorities estimate that the white race numbers perhaps 800 millions and the yellow race 600 millions. Thus these two groups include about two-thirds of the world's inhabitants. The blacks and the reds (Amerinds) together are estimated at under 200 millions. This leaves something like 500 millions of the brown race and the uncounted millions of mixed stock. The white group increased at an average rate of about one per cent a year from 1800 to 1930. Other races together increased about half as fast.

Figures for Europe and other lands where birth statistics are accurately kept show that there are

more boys born than girls, the excess ranging from 20 to 60 more boys in every 1,000 births. But more boy babies die than girls, and men are more exposed to death from industrial accidents, war, and other causes than women; so that in most highly civilized countries the women outnumber the men. Even before the first World War there were more women than men in Europe, owing partly to the fact that men tend to emigrate more than do women. America and Australia, which receive Europe's overflow, show a larger proportion of men. In Asiatic and African countries, where the conditions of women's life are harder, their death rate is higher and men apparently outnumber the women. For the world as a whole there are slightly more men than

women, although with the white race alone the proportion is reversed, women being in the majority.

How Many Can Read and Write?

Statistics on illiteracy are not strictly comparable since the term is sometimes defined as inability to read, sometimes as inability to write, and often as inability to read and write. In the United States, Canada, and several other countries the figures are computed for persons 10 years of age and over, but in most countries the application is to 5 years of age and over.

Illiteracy is less than 1 per cent in Denmark, Norway, Sweden, England, Scotland, Switzerland, Germany, and the Netherlands. For the continental United States it is approximately 4.3 per cent. Australia, Belgium, Canada, France, Ireland, and Japan also have less than 10 per cent illiteracy. Most of the other European countries, and Argentina, Chile, and Uruguay have rates between 10 and 50 per cent, while more than half of the population of Portugal, Mex-

ico, Central America, and the tropical South American countries are illiterate. The highest illiteracy, 90 per cent and over, is found in the Dutch East Indies, Egypt, India, and South Africa.

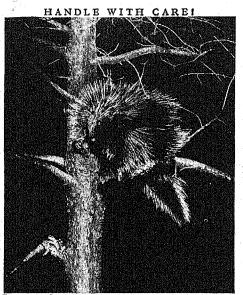
PORCUPINE. "Like quills upon the fretful porcupine" is a comparison that has been common ever since Shakespeare put it into the mouth of one of the characters in 'Hamlet'. This large but sluggish rodent is remarkable for its defensive armor of quills or spines, which usually lie flat on its body but are raised into a formidable and bristling array in time of danger. These spines, which are really hairs modified by long evolution, range from an inch or so to a foot in length, and are intermixed with the animal's

hair. The general color is a grizzled black or brown mingled with white.

The best known American species, called the Canadian porcupine (Erethizon dorsatum), measures about two and onehalf feet in length, including its short tail, and weighs up to 20 pounds. It is found chiefly in Canada and in New England, New York, Pennsylvania, and westward. Its days are spent in hiding in hollow trees and among the rocks, feeding chiefly at night. It is practically omnivorous so far as fruits and vegetables are concerned, and feeds upon the bark and twigs of many of the trees, and on the leaves and stems of water plants. It is a good climber in spite of the fact that its tail is not prehensile, as is the case with South American species.

The flesh of the porcupine is edible and is considered quite a delicacy by the Indians. The laws of some of the states protect it because it is a source of food to persons lost in the woods. The Indians dye the spines various colors and use them in their beadwork. In the Old World porcupines, of which there are a number of species, alike in Europe, Africa, and Asia, usually live in burrows. All porcupines are great gnawers, and around camps in the northern woods of America boards and planks may usually be seen which have been gnawed through for the bacon fat or salts which they contain.

Contrary to a common belief, the porcupine cannot "shoot" its quills at its opponents; such stories arise from the fact that the quills are loosely inserted in the skin and become detached at a touch. They make painful wounds, for small barbs at their tips cause them to work deeper and deeper into the flesh of its victims. The porcupine is sometimes called a hedgehog, but this name properly belongs only to the European hedgehog (see Hedgehog).



Interrupted on one of his nightly forays into the tree tops to lunch on the soft inner bark, this North American or Canadian Porcupine raised his quills to the utmost when startled by the sudden glare of the flashlight as this picture was taken.

PRICKLES LEARNS to LIKE HIS QUILLS



RICKLES the young porcupine, lived in a little cave by the edge of a wood. He was called Prickles because his back and sides were covered all over with long, prickly quills—white quills with black tips. Even his tail was covered with quills. His head was small and his legs were short and stumpy.

"Oh, dear!" he would often say to himself. "I wish I had nice soft fur like the squirrels. Fur would be much nicer than quills." But he could not change his quills, because all porcupines have them.

Prickles usually slept all day, but this afternoon he was very hungry. So he got up bright and early to look for his breakfast. There was plenty of bark on the trees for him to eat, but he was tired of eating bark. There were plenty of nice juicy twigs, but he was tired of eating twigs, too.

"I wish I could find something new to eat," he thought, "something I have never had before."

All at once he saw a dark hole under the roots of a big tree. "I wonder what is in that hole," thought Prickles. He went a little nearer—something moved inside the hole. He went still nearer—two small eyes looked out at him.

"Oh!" cried Prickles. "Who are you? What is your name? Do you live here?"

The two eyes blinked back at him for a moment and then, very slowly, a large porcupine squeezed through the hole and stood right in front of Prickles.

"You ask a lot of questions," said the porcupine, "but that's all right. You are young and you have many things to learn. My name is Old Quills," he went on politely, "and this is my den. I usually sleep through the day and hunt at night."

"I have a den, too," said Prickles, "but it is smaller than yours. Have you lived here long?"

"I have lived here a long time, little porcupine," answered Old Quills, "for I am very old. I have seen six summers and six winters."

"My!" said Prickles, "you are old, aren't you!" Old Quills shuffled slowly off to look for his breakfast, and left Prickles standing all alone.

"Wait a minute!" cried Prickles. "I want to go with you!" He couldn't walk very fast because his legs were so short, but he walked as fast as he could. A saucy chipmunk scurried past him and called back, "What a slow walker you are, porcupine! Don't you wish you could run as fast as I can?"



Prickles knew he was slow; but he couldn't go faster, no matter how hard he tried. So he just walked on and didn't answer the chipmunk, but his feelings were hurt. Pretty soon he saw Old Quills waiting for him by a hemlock tree.

"Come along, little porcupine," said Old Quills. "I will show you where there are a lot of fine lily pads. They are tender and green and very good to eat."

"Oh, goody!" cried Prickles. "I am so hungry that I could eat them all."

As they shuffled along on their stumpy legs, the little creatures of the woods peeped out from their nests and burrows to look at them.

"See the clumsy porcupines!" said a rabbit. "Did you ever see such awkward creatures in all your life?"

"Shhh!" whispered a squirrel. "They might hear you and stick you full of quills."

"Pooh," laughed the rabbit, "they won't hear me. Porcupines can hardly hear at all. Anyhow, I am too fast for them."

At last Prickles and Old Quills came to a little pond covered with the loveliest lily pads. "Here is our breakfast," said Old Quills, pulling out a lily pad and munching it slowly. "There is enough here for both of us, and more too."

"I am going to eat all I can hold," said Prickles. "My! they look good!"

He grabbed the nearest one in his mouth and ate it greedily. *Mmmm*—it was tenderer and juicier than

anything he had ever eaten. He ate another, and then another. How good they were!

Then Prickles saw the biggest lily pad of all. It was round and green and smooth, and he wanted it very much.

"Maybe if I stretch hard, I can reach it," he thought. So he leaned out as far as he could and tried to seize it with his sharp teeth. The big lily pad was just out of his reach. He leaned out a little farther and—splash! he fell right into the water!

Prickles was so frightened that he splashed and kicked with all his might. "Old Quills! Old Quills!" he called, when he finally caught his breath. "Come quick and help me out!"

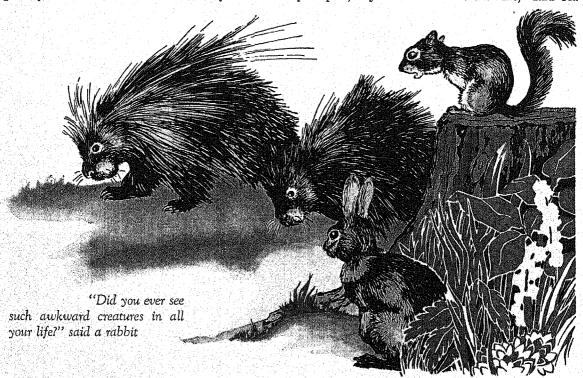
But Old Quills just stood on the bank and chewed his lily pads.

"Don't be frightened, little porcupine," he said. "Your hollow quills will keep you up and make you float like a piece of wood. We porcupines don't have to swim if we don't want to," he added proudly. "We just float."

Prickles stopped his splashing and kicking and, sure enough, his quills held him up, just as the old porcupine had said!

"What fun it is to float about on the water like this!" thought Prickles. "I like to float," he said aloud, "it is great sport."

"You had better get out of the water now, young porcupine, if you want to come with me," said Old





Quills. "I am going to my hemlock tree up on the hill."

"Oh, I do want to go with you, Old Quills!" cried Prickles, as he paddled to the shore. "Please wait for me!"

So the old porcupine waited until Prickles had climbed out on the bank.

"Now then," said Old Quills, "let us go!"

"Ha! Ha!" screamed a bluejay, as the two porcupines shuffled clumsily along. "Look at the funny porcupines! *They* can't fly or run. They can't even walk very fast."

"I don't like to be made fun of," little Prickles said to Old Quills. "I know I can't walk fast and I know I look clumsy, but I wish the other creatures wouldn't laugh at me."

"Don't pay any attention to them," said Old Quills, "we porcupines can do some things that they can't do."

"What?" asked Prickles.

"Well, we can float for one thing," said Old Quills.

"Yes, and that's fun; but we can't run like the squirrels and chipmunks," said the little porcupine. "They think we are slow and clumsy."

"We don't have to run," replied Old Quills. "Other creatures run when they smell danger, because they are afraid. We aren't afraid of anything, because we know how to protect ourselves."

"How do we protect ourselves, Old Quills?" cried Prickles eagerly. "Tell me, won't you?"

"It's very simple," the old porcupine said. "Your sharp quills are your weapons. You haven't any quills on your nose, so if a creature tries to harm you, turn your back to it, put your nose between your forepaws, and then thrash about with your tail as hard as you can. If the creature tries to touch you then, he will get his nose stuck full of your sharp needles. That will teach him to leave you alone, because a nose full of your needles hurts. Most creatures have learned not to bother us."

"Oh," said Prickles, "then we are as clever as the other forest creatures, aren't we? Is there anything else we can do?"

"Yes," said Old Quills, "there is another thing."

"What is it? What is it?" cried Prickles.

"Well," said Old Quills, "whenever I get sleepy or tired I crawl into the first little hole I see and curl up with my prickly back in the mouth of the hole. I won't be bothered, because if any other creature tries to get into the hole, he gets stuck with my quills."

"Oh," cried Prickles, "I want to try that!"

"You will have to find a hole first," said Old Quills.
"I am going to my hemlock tree at the top of the hill.
There is nothing I like better to eat than bark and twigs, and that hemlock tree has the nicest bark and twigs in the whole forest."

K. D'AMA'Q.X

While Old Quills climbed slowly up the hill, Prickles looked around for a hole to sleep in.

"I guess there are no holes in this hill," he thought, after he had looked and looked. "What shall I do? I am so tired and sleepy."

Just then Prickles saw something black a little farther up the hill. "It looks like a fine sleeping hole," he said. "Hurray! There's just room for me." He crawled into it as fast as he could and put his prickly back right up against the opening.

"Now nobody can bother me, or make fun of me," he thought. "I can sleep just as long as I want to."

By and by he was awakened by a noise outside. He couldn't see out, but he knew from the grunting noise that it was a young groundhog.

"What do you mean by lying in my hole!" the groundhog scolded. "The very idea! Come out this minute!" But Prickles lay very, very still. The young groundhog tried to push his way in. Foolish groundhog!

"Oh me! Oh my!" he cried. "What have you done, porcupine! You've stuck me full of quills. My poor nose! My poor nose!"

"Oh, I'm sorry, groundhog," said Prickles. "Why weren't you more polite? You should have known better than to push a porcupine around."

"I will surely know better the next time," said the groundhog, as he tried to pull the quills out of his nose. "I will never make fun of a porcupine again as long as I live."

"You may have your hole now," Prickles said.
"I've had a good sleep and I must go and find Old Quills. Goodby, I'm sorry I hurt you." The ground-hog didn't answer. He was too busy rubbing his sore nose.

Prickles had not gone far before he saw Old Quills coming toward him. "Did you find a hole, little porcupine?" Old Quills asked.

"Yes," said Prickles, "I found a groundhog's hole. He came home and started to push in. When I left him he was busy pulling my quills out of his nose."

"Ho—ho!" chuckled Old Quills. "You are learning fast. All the creatures will soon learn not to make fun of you. And now let's go home. You have had an exciting day for a little porcupine, and we have a long walk."

So Prickles and Old Quills started home. Prickles was very happy.

"I would rather be a porcupine than any other creature in the forest," he told Old Quills, as they shuffled along. "Porcupines can do so many many things."



PORPOISE (pôr'pôs). These lively inhabitants of coastal waters are among the smallest members of the cetacean or "whale" order. Ocean voyagers often tell of the large schools of "porpoises" that they saw; but if those schools were sighted when the ship was far from land the animals were probably dolphins and not porpoises (see Dolphin). The porpoise lives close to the coast, and often enters harbors and even rivers in search of food. It can be readily distinguished from the dolphin by its blunt snout. The snout of the dolphin is long and sharp, like a flat beak.

The porpoise (genus *Phocaena*) is not a fish. It is a mammal; the mother nurses the young with her milk. Like the whale, the porpoise breathes through a single nostril, the "blow-hole," located on top of the head, which is opened during the animal's frequent trips to the surface. Two black "flippers" or fins serve as forelimbs, and there is an upright triangular fin on the back. The tail is horizontal—to propel the animal in its lunges and dives—not perpendicular like the tails of fishes.

The common, or harbor, porpoise is five to eight feet long and usually black on top and white beneath. Under the skin is a layer of fat or blubber about an inch thick. This gives a decided taste to the meat, which is nevertheless edible and was once a popular article of diet in Europe. It has 40 to 50 teeth in each jaw.

The porpoise usually swims in a series of long graceful curves which bring its blow-hole to the surface and then expose the back fin as it dips downward. When you see a number of porpoises or dolphins undulating along in file, you can readily see how some sea-serpent tales got their start.

Porpoises are common on the coasts of the North Atlantic, where their chief food consists of mackerel and herring. The bay-porpoise of the Pacific coast is the smallest member of the whale group, being often not more than four feet long. Other species reach eight feet. Their thick hide is sometimes made into soft leather and their fat yields oil of especially fine quality (see Whale).

A particularly interesting relative of the porpoise is the narwhal (Monodon monoceros). In the male narwhal one of the teeth of the left upper jaw projects forward in a long straight tusk, about half the length of the body. The full-grown narwhal has a body about 16 feet long. Narwhals are found chiefly in the Arctic Ocean.

PORTER, DAVID DIXON (1813–1891). Second only to his foster-brother, Admiral Farragut, in naval achievements during the Civil War was David Dixon Porter. He was the son of Commodore David Porter, who had commanded the famous frigate Essex during the War of 1812. As a boy he had had an exciting career. At the age of 12 he sailed with his father in an expedition against the pirates in the West Indies, and when 14 he entered the Mexican navy of which his father was, for a time, commander-in-chief. While in this service he was captured by the Spaniards

with whom Mexico was then at war. After his release he entered the United States navy as a midshipman, in 1829, saw service on a paddle-wheel steamer in the Mexican War, and made two trips to the Mediterranean countries to procure camels for army use in the Southwest.

At the outbreak of the Civil War, Porter was promoted to the rank of commander in the navy and during the war he helped to win three important victories. First, when Farragut attacked New Orleans, in April 1862, Porter's fleet of mortar-boats bombarded the forts below the city so fiercely that Farragut was able to pass through in comparative safety and capture the town. Then, with a fleet of gunboats Porter cooperated with Grant in the siege of Vicksburg, guarding the city so closely by water, while Grant cut it off from outside communications by land, that it was forced to surrender on July 4, 1863. Finally, in the attack on Fort Fisher, in 1865, Porter—now a rear-admiral—commanded the fleet which cooperated with the land forces of General Terry, helping to capture that fort, and with it Wilmington, N.C., one of the last Atlantic ports open to the Confederates.

At the close of the war, in 1865, Rear-Admiral Porter was made superintendent of the naval academy at Annapolis. As a final recognition of his services, he was appointed in 1870 to succeed Farragut as an admiral of the United States navy, a rank which was not given to another until 1899, when it was conferred upon Rear-Admiral Dewey for his victory over the Spanish fleet at Manila Bay.

PORTER, WILLIAM SYDNEY ("O. HENRY") (1862–1910). "A man may see so much that he'd be bored to turn his head to look at a \$3,000,000 fire or Joe Weber or the Adriatic Sea. But let him herd sheep for a spell and you'll see him splitting his ribs laughing at 'Curfew Shall Not Ring Tonight', or really enjoy himself playing cards with ladies."

When America's most popular short story writer wrote that, he was probably thinking of the sheepherding days of his own eventful career. As a shy freckled small boy in his native town of Greensboro, N.C., William S. Porter,—who became famous under the name "O. Henry"—was fond of 'The Arabian Nights' and other books, of roaming in the fields by himself, of cartooning his friends, and of spinning for them many exciting yarns. Even in those days he was "different." He once explained with modest pride that his feet were freckled.

After attending a school kept by his aunt, young Porter continued his education only in the "School of Good Books" and in the "University of Hard Knocks." Ill health compelled him to give up clerking in the town drug store and to go to work on a friend's ranch in Texas. There in the Southwest he also tried writing short stories, working in a bank, and making up jokes for the papers. After eloping one moonlight night in a borrowed "buggy" with a charming young schoolgirl, he began experiencing the

ups and downs of a varied journalistic career. For a year he edited a humorous weekly called *The Rolling Stone*, furnishing most of the copy himself. After this he worked for a time on the Houston *Post*.

Then came a bitter experience. He had resigned some time before as teller of the First National Bank of Austin. Now he was called back to answer a charge of embezzlement. The affairs of the bank had been handled so loosely that, long before, Porter had protested that it was impossible to make the books balance; and if he had stood trial he would doubtless have been acquitted. But he impulsively decided that he would start life over again and he went to Central America. Hearing of his wife's illness, he returned to Texas and gave himself up. The fact that he had fled from justice weighed heavily against him and he was sentenced to the penitentiary. After his release in 1901 he went to Pittsburgh, and the following year he settled in New York. Something of his old lightheartedness was gone; it was now that his literary work began in earnest.

He saw deep down into the heart of New York. He observed ordinary men and women from a bench in the park or from a table in the restaurant. Clubman or hobo, policeman or thief, the colonel's lady or Judy O'Grady—to "O. Henry" one is as important as the other. And his settings have a large geographic range. Hence his stories have a wide appeal, for no one feels barred from the world in which his characters move.

A master technician in the art of short-story writing, "O. Henry" is famous for experiments in plot and for the surprise endings which give his stories a particular zest. His influence on other writers both in the United States and abroad has been large.

Collections of "O. Henry's" short stories were published under the following titles: 'Cabbages and Kings' (1904); 'The Four Million' (1906); 'Waifs and Strays' (1906); 'The Trimmed Lamp' (1907); 'Heart of the West' (1907); 'The Gentle Grafter' (1908); 'The Voice of the City' (1908); 'Roads of Destiny' (1909); 'Options' (1909); 'Whirligigs' (1910); 'Strictly Business' (1910); 'Sixes and Sevens' (1911); and 'Rolling Stones' (1912). The story of his life as told in 'The Caliph of Bagdad', by R. H. Davis and A. B. Maurice, is as dramatic as any of his own creations.

OREGON'S Metropolis, City of ROSES



The Busy and Beautiful City with Mount Hood in the Distance

PORTLAND, ORE. Air travelers flying to Portland for the first time can see the reasons for the city's importance long before they land at the municipal airport. Spread below their plane is the vast Columbia River basin, with its wealth of farms, fisheries, timber, and waterpower. Portland is the gateway to this mighty realm of some 300,000 square miles—a region larger than the Atlantic States, from Maine to South Carolina, put together.

The key to Portland's commanding position is water transportation. Situated in far northeastern Oregon, the city lies on both sides of the Willamette River, 14 miles southeast of its confluence with the Columbia. A channel 500 feet wide and 35 feet deep, built by the Federal government and the city in 1905–18, enables ocean vessels to reach Portland, 113 miles

inland from the Pacific Ocean. Hence Portland is the center for industries of the giant Columbia basin. This advantage has made it the chief city of Oregon, with about half the state's manufactures and about a third of the state's total population.

Few cities have so beautiful a natural setting. With an area of approximately 70 square miles, Portland spreads up the green slopes of the Coast Range foothills. Its terraced residential districts look out over the Willamette Valley fruit ranches to the south, the great Columbia to the north, and the forested Cascade Range on the east. About 60 miles southeast, snow-capped Mount Hood crowns the scene.

Visitors enjoy another unique beauty of Portland—its roses. Nearly every home grows them. Many varieties, including the official bloom called the

Caroline Testout, brighten the more than 2,000 acres of public parks. In Washington Park, cuttings from all over the world are cross-grafted in the International Rose Test Garden. The annual Rose Festival. in the second week of June, has been an official city celebration since 1907.

Nearness to the warm Pacific, with its prevailing westerlies, gives the city the moderation of an oceanic The mean annual temperature is 53° F. Summer has usually "perfect vacation weather," bright with sun, for only about one-seventh of the annual precipitation of 41.62 inches falls from June to September inclusive. In winter there is little ice in the rivers, snows are light, and because the Coast Range partly dries the sea winds, Portland usually has less than 20 days a year of heavy fog.

Approximately 30 miles of deep-water frontage makes Portland the first large port north of San Francisco and one of the chief fresh-water ports of the nation. The water-level route through a large part of the Columbia basin provides fine facilities for rail and

truck transport.

Chief products are lumber and millwork. About 400 billion feet of timber, over a fifth of the nation's entire reserve, stand within a radius of 150 miles. Cattle and grain from the Columbia plateau supply Portland's meat, leather, and milling industries. Salmon and fruits and vegetables from the Willamette Valley make it a canning center. Woolen goods and paper are also important. During the second World War shipbuilding soared.

About half its commerce is coastwise trade, chiefly with Atlantic and Gulf ports. Over a third is internal, and about an eighth is foreign, principally exports, many of which are normally destined for the Orient. Portland is the Pacific coast's largest exporter of wheat and live stock, and one of the chief lumber ports. Leading imports include petroleum, iron and steel, chemicals for paper manufacture, corn, copra, and fibers for manufacture of sacks and cording.

Nearness to ample hydroelectric power gives Portland an immense industrial advantage. Much of this cheap power comes from Bonneville Dam, 42 miles up the Columbia (see Columbia River; Dam). Most of the more than one thousand factories use electricity, which keeps the city remarkably clean.

Portland's water supply is brought by gravity from Bull Run Lake, 3,000 feet high on Mount Hood. This melted glacier water is so pure that it is suitable in the manufacture of textiles, and needs no distillation for use in electrical equipment. It helps to give Portland a very low death rate.

Public buildings of Italian Renaissance style add to the beauty of the city. The civic auditorium seats 6,700 persons. It also houses the collection of the Oregon Historical Society. Educational centers are Reed College, University of Portland (Catholic, and formerly Columbia University), the medical school of the University of Oregon, and the art school of

the Portland Art Museum.

The city's beauty, climate, and excellent recreational facilities make it a favorite with tourists. Sight-seers delight in Peninsula Park, with its 1,000 or more varieties of roses; and in the view from Council Crest Park (1,107 feet), highest point in the city. In Washington Park is the statue of Sacajawea, the "Bird Woman" who guided the Lewis and Clark Expedition. Mount Tabor Park has Gutzon Borglum's statue of Harvey W. Scott, historian and early editor of Portland's distinguished newspaper, the Oregonian. Music lovers throng to Multnomah Stadium (named for a near-by tribe of Chinook Indians) for summer "starlight symphonies."

Columbia River Highway and the Pacific Coast Highway ribbon through majestic scenery. The Loop Drive to the summit of Mount Hood reveals the dramatic beauty of this glaciated, semi-extinct volcano -now a national forest, with facilities for year-round sports. Salmon fishing is famous in both the Columbia

and the Willamette rivers.

Portland sprang from a Chinook Indian "landing" on the west bank of the Willamette. The site was claimed in 1844 by William Overton of Tennessee and shared by Amos L. Lovejoy of Boston. Overton traded his share to Francis W. Pettygrove, a merchant from Portland, Me., who tossed a coin with Lovejoy to determine the name of the planned town. Pettygrove won, and the city was incorporated in 1851. Until late in the 19th century it was an exuberant frontier town, supply center for the gold rushes of California and Alaska and for the army in the Indian wars. In 1905 Portland held the Lewis and Clark Centennial Exposition, and many visitors became residents. From 1900 to 1910 the population almost doubled. Since 1913 the city has had the commission form of government. Population (1940 census), 305,394,

PORTO RICO-KEYSTONE of the WEST INDIES

PORTO RICO OF PUERTO RICO (pwěr'tô rê'kô). This enchantingly beautiful island, the fourth largest of the West Indies, owes its name to Ponce de Leon, its first governor. The name means "rich port" (long spelled Porto Rico; but the correct Spanish spelling was readopted in 1932). The island is about 1,400 miles from New York and 900 miles from Miami.

For four centuries it was ruled by Spain. On Dec. 10, 1898, after the Spanish-American War, it was ceded to the United States. The island is thus a meeting ground for two civilizations—the old Spanish and the modern American. The majority of the people speak Spanish, but the younger generation is rapidly acquiring English. Racially also there is great variety. About three-fourths of the inhabitants are white, chiefly of Spanish descent; the remainder have a mixture of Negro, white, and some Indian blood. Out of this background has come a varied and interesting people.

They Raise Sugar, Tobacco, and Coffee

The smoking stacks of the sugar mills or "centrals," the huge tobacco-curing barns, and the cement-floored coffee-drying yards indicate to the visitor the

THE BEACH WHERE COLUMBUS LANDED



On this beach near Aguadilla, Porto Rico, Columbus is said to have landed in 1493, on his triumphant second voyage with 17 ships and 1,500 men seeking gold and glory. It is the only bit of United States soil actually seen by Columbus.

three great products of Porto Rico's rich soil, in their order of importance. Sugar cane is commonly cultivated by hand on the coastal lowlands by laborers who earn 50 cents to \$1.50 a day and work only five or six months a year. The sugar worker owns little or no land and must buy his food from the store. Money means a great deal more to him now than in Spanish days, when he grew most of his food.

Ills Charged Against Sugar Industry

Porto Rican sugar enters the United States duty free. That is why sugar growing has increased greatly of recent years. The Porto Ricans complain that the laborers lose their independence when they work for the big American sugar corporations, and that too much of the sugar profit leaves the island. They say

they could raise enough food to feed themselves cheaply, without importing half of it at considerable expense, if so many acres and so many men were not working for King Sugar. The United States is urging the farmers to raise more rice, corn, and beans, the daily diet, and fewer crops for export.

Porto Ricans control most of the valley lands producing tobacco and the steep, wetter, higher places where coffee is raised. As compared to the sugar worker, the mountaineer who raises coffee is an independent soul, with his garden of plantains, bananas, corn, coffee, vegetables, and sweet potatoes, which he weeds with slashes of a machete. Coastal farms export grapefruit, oranges, pineapples, and Dairying is important coconuts. around the cities. More than twothirds of the Porto Ricans still live in the country, although the movement towards the cities is increasing. The government agricultural experiment station at Mayaguez is adding greatly to the list of profitable crops. Streams still wash down a few gold nuggets, but the metal has not been mined since Spanish days. Manganese is shipped out, and marble and limestone are quarried for building. Salt is evaporated from sea water, brick and pottery are made from clays, and stucco and fertilizer from gypsum. Other minerals are too scattered or inaccessible for mining.

More Factories Wanted

The Porto Ricans want more factories to provide more jobs. The island has cheap, intelligent labor, hydroelectric power from numerous mountain rivers, and water transportation to many markets. Besides the sugar mills which turn out raw sugar and

molasses, there are cigar and cigarette factories; coffee cleaning and preparing establishments; canneries shipping grapefruit, pineapple, and fruit juices; and a few foundries and machine shops. For a few cents a day, women make artistic lace and drawnwork and do other needlework at home and in cotton garment factories. Pearl buttons, alcohol, "Panama" hats, hides, cotton, bay rum, and paper are other exports of Porto Rico. Its trade is mostly with the United States. Imports include foodstuffs, cotton goods for the needlework industry, tires, shoes, chemicals, machinery, minerals, wood, and paper.

Railroads connect cities along the coast and serve the sugar industry, but the interior still sends its produce to the ports on the backs of donkeys, or in great

BUSY AND MODERN IS SAN JUAN TODAY



The fine new Postoffice and Federal Building in San Juan. Porto Rican capital, is only one of the many smart modern buildings which mark the American régime. Built on a small island, the city is connected by bridges with Porto Rico proper.

A PORTO RICAN TOBACCO FIELD



Next to sugar cane, tobacco is the most important Porto Rican crop. The plants you see in the foreground are being grown under the shadow of fine cheese-cloth, to improve the delicate quality of the leaf. The huts are used for storing and drying the leaves.

tarpaulin-covered wagons drawn by several teams of mules, or occasionally by ox-team. Passengers and mail travel by public motor-bus. About half the 3,200 miles of roads are asphalted; but clayey, often impassable byways still cut off thousands of acres from

cultivation. As elsewhere in this region, airplane transport helps greatly.

When a Porto Rican needs fuel, he cuts down a tree to make charcoal. Thus, many miles of once deep forest have become bare, but reforestation has been started. The island has palms, cedar, ebony, calabash, and bamboos and is brilliant with purple sprays of bougainvillea, orchids, and showy petals of hibiscus. The chief songster is the "co-kee," a little tree-frog. Birds are scarce for a tropic isle, because they have been frightened away by the fierce storms, by the lack of trees, and by their enemy, the mongoose. A snake similar to the boa constrictor inhabits the island. Shrimps, lobsters, turtles, starfish, crabs, and meaty bright-colored fish are among its sea creatures.

Only about half the children go to school; there is no room for more. The boys till the farms which surround the newer type of country school and they are taught carpentry, barbering, shoe making, and other trades, besides "readin', 'ritin', and 'rithmetic." The girls study home economics. The country grade schools are taught in Spanish, but the upper city grades are taught in English. Besides high schools and several

industrial schools, the island has a government university, founded in 1903 near San Juan, with a notable school of tropical medicine. The percentage of illiteracy has been reduced to 35 per cent—less than half what it was in Spanish days.

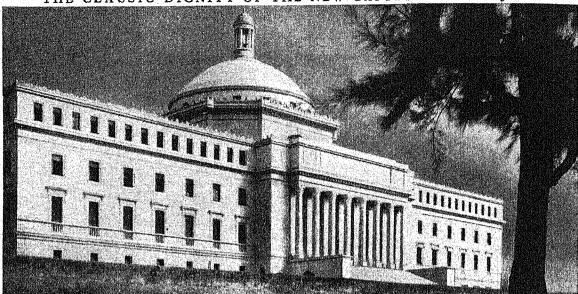
Surface Largely Mountainous

This sunlit island of the West Indies is extremely mountainous. When Queen Isabella asked Columbus what the island looked like, he crumpled a piece of paper, threw it on the table, and replied, "It looks like this!" The land is flat only along the narrow rim of the coast. The Cordillera Central, Luquillo, and Sierra de Cayey ranges cross the island from east to west. Cerro de Punta, 4,399 feet, near Ponce, is the highest point. The long northern slope is well watered and is farmed from bottom to top. On the semi-arid southern face, which is much narrower, irrigation is necessary to raise crops; for the moisture-laden northeast



The coffee planter of the central Porto Rican uplands is an independent soul who asks little of modern methods in this business of coffee hulling. He likes the old ways, as you see here.

THE CLASSIC DIGNITY OF THE NEW CAPITOL AT SAN JUAN



Porto Rican problems of government are being worked out in this beautiful Capitol, which strongly resembles the government buildings at Washington, D. C. It is one of the many handsome public buildings recently erected on the island.

trade winds, which blow all the year round, drop most of their precious load on the north side of the mountains. The average temperature is 80° F., with little variation throughout the year. At times the island is parched with drought. Again it is swept by deadly hurricanes, though these storms move so slowly that there is usually ample warning of their approach. One storm, on Sept. 13, 1928, wrought damage estimated at \$85,000,000, and caused many deaths and injuries.

The Island Is Crowded

But natural hazards are not the greatest worries of the people. Their basic problem is overpopulation. The island is about 100 miles long and 35 miles wide. Its area, including adjacent small islands, is 3,435 square miles—not as large as Connecticut. Within these narrow limits live 1,869,255 people. Porto Rico is thus one of the most densely populated regions in the world. Its population numbers more than 500 persons to the square mile, as compared with less than 45 to the square mile in continental United States.

The island is unable at present to support this population in comfort for several reasons. First, it lacks most of the raw materials necessary for industrial development. Second, its soil is not properly or thoroughly cultivated. Third, the land is concentrated in the hands of a few, so that the great mass of the farmers are not only landless but frequently without work. Slums, undernourishment, and insufficient medical care have combined to give the island a death rate twice that of the United States. Tuberculosis, malaria, and intestinal diseases are the major afflictions.

The Rôle of the United States

Most of these social and economic ills existed in a more aggravated form before United States rule began, and the American government has made increasing efforts to better the condition of the islanders. In 1935 the Puerto Rico Reconstruction Administration was created to undertake a long-range program of reform. Large estates, purchased by the government, are being broken up and leased as small farms to the landless peasants (*jibaros*). Efforts are being made to enforce a long-standing law prohibiting ownership of plantations of more than 500 acres. Slums are being cleared and replaced by well-built apartment buildings. Educational and medical facilities also are widening.

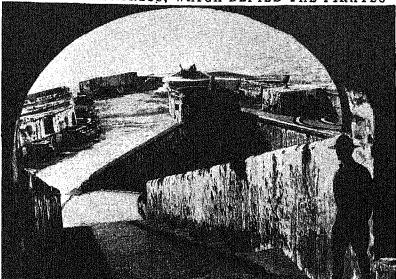
But despite these benefits, many of the people favor complete independence. Others desire admission into the Union as a state. The island is an unincorporated territory of the United States, but the Jones Act, passed by Congress in 1916 and later amended, granted the people American citizenship. The senate and the house of representatives are elected by the vote of persons 21 years of age and over. The governor, who has the power of veto, is appointed by the president of the United States. A resident commissioner is popularly elected for a four-year term in the United States Congress but he has no vote.

The island flanks the Mona Passage, which offers the shortest ship route between Europe and the Panama Canal. The United States therefore maintains strong naval, army, and air bases here and in the adjoining Virgin Islands. These bases are administered as a naval district and an army overseas department.

San Juan and Other Cities

San Juan, the capital and largest city, is on an island off the north coast. It possesses an excellent harbor. On the mainland, across the San Antonio Bridge, lies the residential section. The whole city has an Old World charm, with its buildings of many-

EL MORRO FORTRESS, WHICH DEFIED THE PIRATES



The grim, time-stained walls of "Morro Castle," the old fortress of El Morro, which successfully protected San Juan from Caribbean pirates, now houses a military school for Porto Rican members of the American army stationed on the island. It was built in the early 16th century by the Spaniards.

colored plaster, its plazas and trees, its narrow, clean streets paved with glazed brick, its churches, castles, and fortifications against the mountain background. Many modern buildings also mark it with a distinctly American air. Another well-built modern city is Ponce, on the south coast. Here cigars, bay rum, hats, and shoes are made. Mayaguez on the west, with a roomy harbor, is the center of the clothing industry for the island.

Discovered by Columbus

The island is the only possession of the United States actually seen by Columbus, who visited it in 1493 and named it San Juan Bautista. That Spanish dreamer, Juan Ponce de Leon, who was with Columbus on the latter's second trip to the New World, came back to the island in 1508 and was ap-

pointed governor. A fine bay that he found there he called *Puerto Rico*. The city that shortly grew up in the bay took the name of San Juan, and the whole island came to be called Puerto Rico.

The Spaniards enslaved the native Indians, the friendly Borinqueños, and forced them to work the gold mines. All the Indians either died or escaped by the 16th century, and African negroes were imported

could not storm the fortresses. The Dutch captured and burned part of the city in 1625, but never penetrated inside Morro. Slavery was abolished in 1873. The peace-loving Porto Ricans revolted half-heartedly against Spanish rule in 1820, and again in 1868, and finally won virtual autonomy in 1897, just previous to the American régime. On the retirement of the Spaniards, a military government was established,

and in May 1900, under the Foraker Act, civil government was instituted.

PORTSMOUTH, ENGLAND. Portsea Island, which lies between two inlets of the English Channel, about 65 miles southwest of London, is the site of the great English naval station and arsenal of Portsmouth.

Portsmouth is really made up of four distinct sections. Portsmouth proper is a garrison headquarters. Portsea, the naval station, has almost a square mile of dockyards. The other sections of the community are Landport, occupied chiefly by houses of the workmen, and Southsea, a residential quarter and seaside resort, commanding a view of the Channel of Spithead and of the Isle of Wight.

Long before 1540 Portsmouth was important as a naval station and trading center, but about that time the Royal

Dockyard was established. This has been enlarged to permit the building and repairing of Britain's largest battleships. During the second World War Portsmouth was repeatedly bombed by the Germans. The intense air raids, starting great fires, caused ruinous damage. Population, about 250,000.

MAKING "PANAMA" HATS IN PORTO RICO



Hat weaving seems to be pretty much a family affair in Porto Rico. The Porto Ricans, deft and artistic as their needlework proves, have readily become skilled in the manufacture of the hats usually called "Panama."

in their places. Two once impregnable and still well preserved fortresses—Morro Castle and San Cristóbal—guarded the entrance to San Juan harbor. Pirates of the Spanish Main could not pass their deadly fire, and even Sir Francis Drake failed in an attack in 1595. The Earl of Cumberland in 1598 took San Juan, but

LITTLE PORTUGAL and Its GREAT PAST

POR'TUGAL. For about 150 years of its history, Portugal was one of the leading powers of the world. Before and after that time it had to struggle constantly for its very existence. It is one of the smallest countries of Europe. With an area of 34,604 square miles, it is

little larger than the state of Maine. Yet, during the 15th and 16th centuries, it discovered and ruled an empire that reached round the world. Then it fell under Spanish rule for half a century and lost most of its colonies. After it regained its independence it had to rely for its security on the protection of more powerful allies.

It still has colonies scattered through both hemispheres. Their total population is about 9,400,000. In area, they total about 808,500 square miles, about 23 times larger than Portugal itself. Some have strategic value for air and naval bases and have rich natural resources. But they are little developed, for Portugal even at home is just starting to build modern schools, highways, and industries.

Travelers find that Portugal is like two worlds one new, one old and picturesque. Its capital Lisbon (Lisboa) at the mouth of the Tagus River on the southwestern Atlantic coast is a handsome modern city. It is a great air-line center and seaport

(see Lisbon). But except for Porto, about 180 nautical miles north on the coast, there are no other large cities. Most of the population of about 7,000,000 are peasants and fisherfolk. About two-thirds of the nation is illiterate. Portuguese are strong, dark-eyed, with olive skin like that of their neighbors, the Spaniards. But they are somewhat shorter and more thick-set. With their ready smiles, they are a gracious and hospitable people,

often colorfully dressed in costumes traditional with each community.

The geography of Portugal ex-

plains the ups and downs of its

Extent.—North to south, greatest length, 362 miles; east to west, 140 miles. Area, 34,604 square miles (including Azores and Madeira Islands, 35,796 square miles). Colonial possessions (Cape Verde Islands, Angola, Mozambique, Guinea, Portuguese India, Macao, Portuguese Timor), about 808,500 square miles. Population (continental Portugal), about 7,000,000. Natural. Features.—Much indented Atlantic coast line forming the west and south boundaries; numerous mountain ranges in the interior separated by river valleys (highest range, Serra da Estrella, 6,532 feet). Principal rivers: Minho, Douro, Tagus, Guadiana.

Guadiana. Products.—Wheat, corn, rye, oats, barley, beans, potatoes, and other vegetables, figs, lemons, and other fruit, clives and clive oil, grapes and wine; live stock, wool hides; sardines, tunny fish; copper pyrites, coal, lime phosphate, tin, tungsten; cork, textiles, embroidery, lace; porcelain tiles and other pottery. Cities.—Lisbon (Lisboa) (capital, 594,390), Porto (232,280).

history. Occupying an outer corner of the Iberian Peninsula, it is the westernmost projection of the European continent into the Atlantic Ocean. On the map, Portugal looks like a narrow pocket patched on western Spain. No sharp natural boundaries divide the two countries divide the two countries divides the support of t

tries. Portugal is largely the western continuation of the rugged plateau (Meseta) of central Spain (see Spain). Hence it is largely mountainous. The only considerable level land is the narrow plain that extends the length of the Atlantic coast line. Central Portugal, the province of Estremadura in which Lisbon lies, is a plateau, but ridged with hills. The highest of Portugal's mountain ranges, Serra da Estrella, is only 6,532 feet. But even the lower ranges are cut with deep and twisting valleys. Through them many mountain streams, rising chiefly in Spain, race westward to the Atlantic. The principal rivers are the Minho in the north, the Douro flowing into the sea at Porto, the Tagus, and the Guadiana, which flows west and south to form part of the Spanish boundary. (For map, see Spain.)

The country's friendly climate encourages easy living. Travelers call it "a land of sunshine." It lies between approximately 37° and 43° north latitude,

in about the same parallels as the area from Connecticut to Virginia. But its long coast line is open to the Atlantic westerlies. These

coast line is open to the Atlantic westerlies. These ONCE A ROYAL CASTLE

Turreted castles crown many bold heights in Portugal. This is the Palacio da Pena overlooking the beautiful little town of Cintra, about 16 miles northwest of Lisbon. The castle, a picturesque mixture of Moorish, Gothic, and Manueline architectures, was begun by Manuel I, 1495-1521. From it he looked out over the Atlantic for the return of the fleet under Vasco da Gama. It was last used by Manuel II, who fled Portugal in 1910, after his extravagances had brought on a revolution.

provide ample rainfall for farming, and temper the climate. The mean average at Lisbon and Porto is between 60° and 61° F., about the same as that for San Diego, Calif. The sheltered deep valleys, however, are very hot in summer. Much of Portugal's

beauty comes from the combination of bright sun and moist air, which gives brilliant color to the flowers, houses, and mountains.

Most of the people dwell on the coastal plain, where the land is easy to work and where the sea affords an abundance of fish. The peasant farmers live in rude houses, usually made of stone and wood, roofed with turf. Roses bloom all year in the yards, and flowering vines brighten the walls. Women do most of the farm work, even plowing with oxen. They earn about 20 cents a day, and the men about 35 cents.

On the many feast days, young and old alike drive to town in high-wheeled oxcarts. There

they play guitars, sing traditional melancholy songs called fados, and watch bullfights in which the humane Portuguese toreadors never kill or severely hurt the bull. Once a year they make a pilgrimage, romaria, to a shrine.

Varied Products of Land and Sea

Wheat is the chief field crop, followed by rye, barley, oats, corn, and rice. Fruits and nuts are raised chiefly in the tiny, southern, lush province of Algarve. Grapes for the celebrated Portuguese wines are raised principally on the terraced rugged slopes of the Douro River valley. Great forests of cork oak in the eastern province of Alemtejo make Portugal

the world's chief source of cork. It is also a leading producer of olive oil, but this is largely used at home for canning sardines. Fishing for sardines, cod, and tunny is a major industry, centering at Setúbal. Manufactures are now encouraged by the gov-

ernment. The centers are Lisbon and Porto. Their products include shoes, corkware, china, glass, paper, farm tools, fertilizers, olive oil, sugar, and textiles. Portugal has little coal, but its many small swift rivers are being developed for hydroelectric power. It has considerable tin,

THEY HARVEST THE SEA



THEY WORK THE LAND

Portuguese peasant women have weathered faces and work-worn hands. They do most of the farm chores. They wear padded hats for carrying head burdens.

copper pyrites, sulphur, radium, kaolin, slate, lead, manganese, tungsten, marble, and gypsum.

The major exports are cork, wine, canned sardines, naval stores, olive oil, and textiles. Most of these in normal times go to Great Britain, Germany, France, the

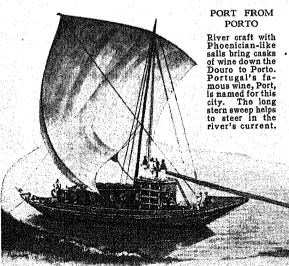
Men sail the bright-colored boats of the fishing fleet. Women clean and sell the catch. This Lisbon merchantholds a "spada," a common cel-like fish with vicious teeth.

Portuguese colonies, and the United States. Imports are largely from the same nations, and are chiefly manufactures, iron, steel, cotton, and petroleum. Porto, through its port at Leixoes, about four miles north, and Lisbon are the centers of foreign trade.

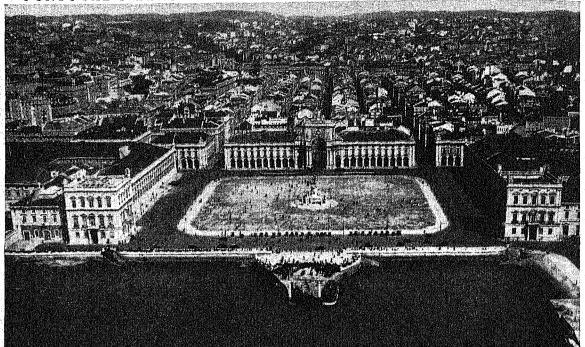
There are about 8,700 miles of highway, but many roads are still mere oxcart tracks. Most of the 2,150 miles of railroad are wider than standard gauge, to facilitate shipment from Spain's similar wide gauge.

Portugal's short, stormy history gave little opportunity for extensive development of the arts. But the

magnificent Battle Abbey, "St. Mary of the Victory," at Batalha is a striking monument to Portugal's rise as an independent nation. It was built by King John I in thanks for his victory over Spain in 1385. Here is the tomb of



PORTUGAL'S BEAUTIFUL CAPITAL IS A SHOWPLACE OF EUROPE



Lisbon faces a superb harbor, formed by a tidal lake in the Tagus River, about 40 miles from the Atlantic Ocean. The city spreads upward on terraced hills. Its white and pink buildings and bright tile roofs glisten in the clear air. The center of public life is the Terreiro do Paco, the great square shown above. Government buildings line it on three sides. In the center is a statue of Joseph I, 1750-1777, who reigned when Lisbon was rebuilt after being leveled by an earthquake in 1775.

his son Henry the Navigator. Spectacular cathedrals and monasteries in the ornate Manueline style (King Manuel I, 1495–1521) commemorate Portuguese feats of exploration. At beautiful Coimbra is the University of Portugal, founded in 1290. It is celebrated for its atmosphere of "noble scholarship." Here studied Luis de Camoens (1524–80), who became Portugal's great poet through his *Lusiads*, an epic describing the triumphs of Vasco da Gama.

Like Spanish, the Portuguese language springs from the Roman. Portuguese uses nasal vowels and is pronounced more like French. The mark - (til) represents n. Hence irmā ("sister") is pronounced irman; são (saint) is pronounced soun. It is a contracted language, yet it is more musical than Spanish, for Portuguese voices are softer.

The early history of Portugal is the history of Spain (see Spain). Under Roman rule, Portugal was merely the western part of the province of Lusitania. Its present name came from Portus Cale ("Door of Cale"), a seaport now a suburb of Porto. The first step toward independence came in 1095. In that year what is now Portugal was given to Count Henry of Burgundy as part of the dowry of his wife Theresa, Spanish princess of Leon. In 1131, a year after her death, her son Alphonso I began a series of wars to win freedom. His victories ended in the Treaty of Zamorra, 1143, in which Spain recognized the new nation.

The period of Portugal's greatness began with Europe's Golden Age of Discovery. For centuries the

Portuguese had grown up with the sea. When southern Europe knew little but the waters of the Mediterranean, the Portuguese were venturing along the Atlantic coast. This gave them enormous advantage, when Europeans began seeking new sea routes to the Indies. The Portuguese navigators were ready to lead the way.

These men of the sea had been given the best available training and equipment by their patron Prince Henry the Navigator (see Henry the Navigator). Daring but seasoned, Portuguese captains began sailing down the coast of Africa, then around Africa to the Orient, and then west to Brazil. Bartholomew Diaz and Vasco da Gama were among them. They conquered an immense empire (see Brazil; Diaz, Bartholomew; East Indies; Gama, Vasco da). During the 16th century Portugal dominated Europe's trade with riches from its colonies (see Commerce).

But the Portuguese were not empire builders. They tried to hold their colonies with garrisons alone. They failed to send out men to develop the natural resources of their possessions. The empire was too vast and too scattered to be held together from afar by Portugal's feeble military power. Other nations were soon disputing its possessions. In 1580 the Portuguese royal family died out. The throne was at once claimed by Philip II of Spain, who seized it in 1581. Not until 1640 did the "years of captivity" end, when Portugal threw off the Spanish yoke. By that time only fragments of its colonies were left. In 1703 the Methuen treaty joined Portugal and England in a

commercial-political pact which became the longestlived alliance in modern European history.

When Napoleon Bonaparte overran the Iberian Peninsula in 1807, the Portuguese king (John VI)

and royal family fled to their great South American colony of Brazil. The British under Wellington threw back the French in what is known as the Peninsular War (1808–14). But the king did not return until 1822, and in that same year Brazil became an independent empire under his son, ending Portuguese power in the New World (see Brazil).

Even leaner years followed. Portugal plunged into bankruptcy in 1892. Dictatorship and revolutions ensued. bringing the abdication of King Manuel II in 1910 and the declaration of a republic. Internal dissension continued, but at the outbreak of the first World War Portugal sent troops to aid its ally England. Civil strife persisted until 1926 when a military dictatorship gained control. Antonio Oliveira Sala-

zar, professor of economics at Coimbra, was appointed minister of finance. In 1932 he became prime minister, and in 1933 civilian dictator.

A new chapter in the history of Portugal began. Salazar promulgated a new constitution. It established Portugal as a corporative state, modeled in some respects on fascist Italy. It provided for a president, a cabinet, a national assembly, elected half by popular vote and half by economic corporations, and a corporative chamber. The state largely controls foreign trade. It successfully encouraged economic development, but the progress in education was slow.

During the second World War, Portugal sent troops to the Azores. It declared it would defend these strategic Atlantic air bases against any aggression. But with its small army and navy, Portugal could not hope to defend many of its far-flung possessions. In December 1941 Britain tried to aid its ally by sending an Australian garrison to hold Timor in the East Indies. But the island was seized by Japan in February 1942. (See also Africa; Azores; Madeira. For military events, see World War, Second.)

Poseidon $(p\bar{v}-s\bar{t}'d\delta n)$. In the days of ancient Greece, Poseidon, god of the sea, was supposed to hold court with all the sea divinities in his golden palace in the depths of the Mediterranean. The Nercids and Tritons attended him when he rode in his sea-shell chariot. Dolphins played about his car, and

at its approach the restless ocean waters grew calm. In his hand Poseidon carried his trident, a three-pronged spear, the symbol of his power. With one stroke of this, the mighty sea god could shatter rocks,

cause earthquakes, call forth storms, or lash the sea to such fury that the very earth shook with the beating of its waves. Mariners prayed to him as the giver of calms and of favoring winds, and in his honorerected temples on jutting headlands, and made sacrifices of rams and great black bulls. Poseidon was also god of all rivers and ruler of the lesser divinities of streams, springs, and fountains.

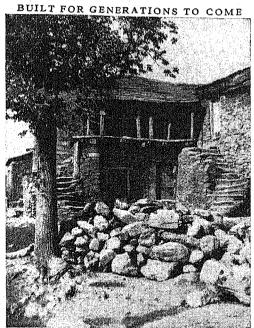
But for all his power, Poseidon was subject to the will of his brother Zeus, who was king of gods and men, and by whom he was once condemned to live for a year on earth among mortals.

It was at this time that Poseidon agreed with Laomedon, king of Troy, that for certain rewards he would build that city's mighty wall. In Homer's 'Iliad' Poseidon, speaking to Apollo, reminds

that god how basely the Trojan king had treated them. "I round their city built a wall," he says, "wide and most fair, that the city might be unstormed; and thou, Apollo, didst herd shambling, crook-horned kine among the spurs of woody, many-folded Ida. But Laomedon robbed us of all hire, and sent us off with threats. He threatened that he would bind together our hands and feet and sell us into far-off isles, and the ears of both of us he vowed to shear off with his sword. So we went home with angry hearts, wroth for the hire he promised and gave us not."

Poseidon revenged himself at the time by sending a great sea monster to ravage the plain of Troy; but Heracles (Hercules) slew the beast, and Poseidon nursed his grievance until the Trojan War. In that conflict between the Greeks and Trojans, Poseidon was always on the side of the Greeks, helping and encouraging them until at last the city lay in ruins. But on the return voyage of the Greeks to their native land Poseidon was hostile to Odysseus (Ulysses) and helped cause the ten years' wanderings of that much enduring hero (see Odysseus).

The Greeks believed that Poseidon was the son of Kronos and Rhea, and was the brother of Zeus and Hades, who ruled the world of earth and the underworld of the dead, as Poseidon ruled the sea. The Romans identified Poseidon with their god Neptune.



This limestone house is a typical peasant dwelling. The rugged mountains furnish an abundance of stone. Live stock is kept in the lower portion, near the open-fire kitchen where savory meals are cooked.

AROUND THE WORLD WITH THE POSTMAN AND HIS PACK



The letter with a foreign address which you drop in the mail box may reach its destination in the strangest sort of conveyance. If it arrives in the Netherlands in midwinter, the postman, in wooden shoes, may push it on a hand sled over the frozen dikes, past creaking windmills, as we see in the picture at left. The Chinese postman, below, may follow a route even more difficult. He may drive a tandem team of sulky little donkeys pulling a two-wheeled, primitive cart over rough and muddy roads if he delivers mail in the rural districts. China was last to join the great postal union which binds the world together and gives the humblest citizen a power of communication that was once the right of kings alone. We know that the Ptolemies enjoyed a mail service for their court. But a world system has existed for less than a hundred years.



Slashing the blue-green waters of the canals of Venice go the speed boats of the Poste Italiane, carrying letters to the watery doorsteps of the Venetians. The letters are locked in gay striped bags of the Italian national colors—red, white, and green. Only the postal boats and the Red Cross boats to rescue the drowning are allowed to use motors in the quiet, small canals where the black gondolas glide smoothly along. At the left we see a delivery launch on the Grand Canal, setting out early in the morning while traffic is still light.



Although the people of India average less than 4 letters apiece each year, the sandal-shod feet of the Indian postmen carry about 1,300,000,000 letters over the hot and dusty roads of this vast country each year. India has practically the same postal rates as the United States or Great Britain, has a parcel post service, and a money-order system which handles more than 40,000,000 money orders a year. The Indian postman at left, with an umbrella hooked on his arm, seems to be prepared for either rain or shine. At the right is a postman of Lapland in northern Norway, delivering mall in his crudely built sailboat. Mail deliveries in this sparsely settled country are infrequent events. try are infrequent events.

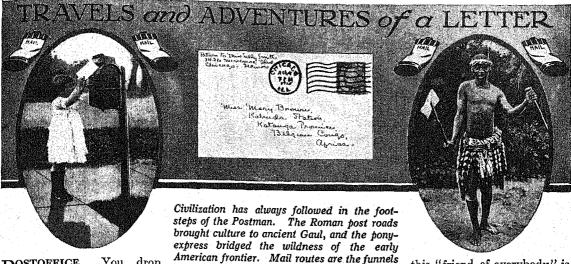








London has its underground "tubes" in which the mail bags ride in cars operated automatically. Two employees are here seen unloading cars. Less rapid methods prevail in the Spreeewald, a watery district of Germany, where the postman poles his craft up to the front door. At right is a street-car in Sweden, with a mail box attached to the front. This remarkable collection of pictures was gathered by White and Wyckoff of Holyoke, Mass., with the aid of officials of various countries.



through which pour ideas. The African savage

running through the trackless forest with a letter

on a stick is a messenger of progress.

Postoffice. You drop a letter into the pillar box at your corner, and in an hour or two it is speeding on its

way to any part of the world—to China or the heart of Africa, to New Guinea or some remote island of the Pacific. It is so easy to send a letter from one part of the world to another that we seldom stop to think what a wonderful organization the postoffice is. The postoffice department of the United States—the largest postoffice department in the world—employs more men than any single private business ever established.

There are about 44,000 postoffices and more than 300,000 employees. They handle one-third of the world's mail, for every hour of every day through the year they receive, transport, and deliver more than 3,000,000 letters, periodicals, and other kinds of mail matter. This service means an expenditure of about \$800,000,000 in a normal year. Every four hours as much is spent on the service now as was spent in an entire year of Washington's administration, when all the government postoffices in the 13 states numbered only 75.

With our swift mail trains and ocean liners, we little realize what letter-writing meant in olden times. You can write from Chicago today to a friend in New York and he will read your letter tomorrow. If your letter catches the early morning air mail, he may read it the same day. In colonial days the letter would have been months on the way. It took at least a week for the journey between Boston and Philadelphia, and the postage rates were so high that people wrote rarely.

Magic of the Postage Stamp

What happens to your letter, after you have placed upon it the magic postage stamp and slipped it under the little green lid of the nearest mail box? Well, it may have more adventures and travels than Gulliver. First, the letter is taken from the mail box by the blue-uniformed postman or collector. Day or night,

this "friend of everybody" is always on the job. Perhaps he is afoot, carrying a big leather bag or two of mail; or

perhaps he has an automobile or a motorcycle or a horse-drawn "United States Mail" wagon, or he works from a postal street-car. He whisks your letter to the central postoffice, where workmen in shirt sleeves and aprons are wheeling big trucks full of letters around. Then, smash! The stamp is cancelled, and your letter is time-marked and dated in machines which work at the rate of 15,000 to 30,000 letters an hour.

How Mail is Delivered

If the letter is to be delivered in your own town it goes into the heap of other "local" mail, which is sorted by carriers' routes, the letters being tossed into big canvas bags by a squad of swift-working clerks, some of them perhaps on roller skates. If there are substations or branch postoffices it is sent to the proper station by trucks, or by pneumatic tubes (see Pneumatic Appliances), or other conveyances. New York City's 27 miles of pneumatic tubes carry on an average 5,000,000 letters a day. From the substation the carrier or mailman delivers it to the proper address. If you put a special delivery stamp on it, a boy on a motorcycle or a bicycle rushes it to its destination as soon as it is received. Mail is delivered free in cities with 10,000 or more inhabitants or with postoffice receipts of at least \$10,000 a year. Villages with 1,500 people or postoffice receipts of \$5,000 also have free delivery.

If your letter is for out of town, it is sent by trucks, elevators, pneumatic tubes, etc., to other departments of the postoffice, where clerks rapidly assort all the out-of-town mail from big tables and boxes into bags arranged in semicircular racks in front of them, one bag for each state. The bags of mail are rushed to steamship docks, railway stations, or airports, where they are tossed into mail cars and airplanes, or shot down chutes into the "sea postoffices" of ships.

The railway mail car, "the backbone of the American postal system," is a miniature postoffice on wheels. The inside walls are a mass of pigeonholes; and the huge bags of mail are arranged all around the floor. As soon as the train is speeding on its way, the railway mail clerks, who must know from 5,000 to 20,000 postoffices and tell instantly on what railroad each is located, as well as a multitude of other points,



A smartly uniformed postman in old Vienna.

sort the letters by towns and villages, tossing them into bag or pigeonhole with astounding speed and accuracy. Only once in 10,000 times is a mistake made. Mail that must change cars is thrown off at terminal and junction points, where it is sorted again. As the mail express roars past the small stations, an iron hook reaches out, automatically seizes a mail bag hung up over the station platform, and jerks it into the car, so that the train doesn't have to stop. By the time the car reaches its destination all mail going beyond that point has been sorted and placed in pouches ready for immediate delivery to the next outbound train. The railway mail car is the

postal system's greatest time-saver.

Finally, when your letter arrives at its destination

it is hurried to the central postoffice, where it is again assorted by substations or carriers' routes and then delivered.

But suppose your letter had been addressed not to a town, but to a farm, or some lonely ranch or mine. Then from the nearest postoffice it would be delivered by rural free delivery. Under this splendid system, which costs Uncle Sam about \$90,000,000 a year, mail is delivered at regular intervals without extra charge by special carriers in "R. F. D." wagons or automobiles. Sometimes they must walk or ride horseback over deserts or forest or mountain trails, braying perils. In Alaska they travel in pairs, driving sled trains of Alaskan dogs over frozen wastes for sometimes as much as 1,000 miles. They must carry food, snowshoes, shotguns, cooking utensils, etc.; and frequently they have to stop to

thaw out frozen feet, fingers, or ears. In Porto Rico some of them ride donkeys, to whose sides are strapped huge boxes of mail.

Valuable letters and parcels may be transmitted by registered mail upon payment of a small extra fee. Mail so registered is put in special pouches provided with rotary locks, having a registering equipment, like that of a cyclometer or speedometer, which records the number of times the lock has been opened. Two clerks count the mail when it is put in, and two more when it is taken out, to prevent theft. If the mail is lost, the sender is indemnified for its value up to \$25 for third-class and to \$100 for first class mail.

Redirecting the Misdirected

Suppose, now, that when you mailed your letter you had addressed it wrong or had forgotten to address it at all. That little stamp will still do its best to deliver it. It first takes it to the big dead letter office in Washington. More than 15,000,000 letters and parcels go there every year, containing \$5,000,000 or so in valuables. Even snakes and dynamite have been found in packages opened there! Most of Santa Claus' mail is held for him in the dead letter office. Clever workers with maps, directories and the like "guess right" about half the time where the mail ought to go, and send



He has to read addresses written in Greek.

it on its journey or return it with its valuables to its careless sender.

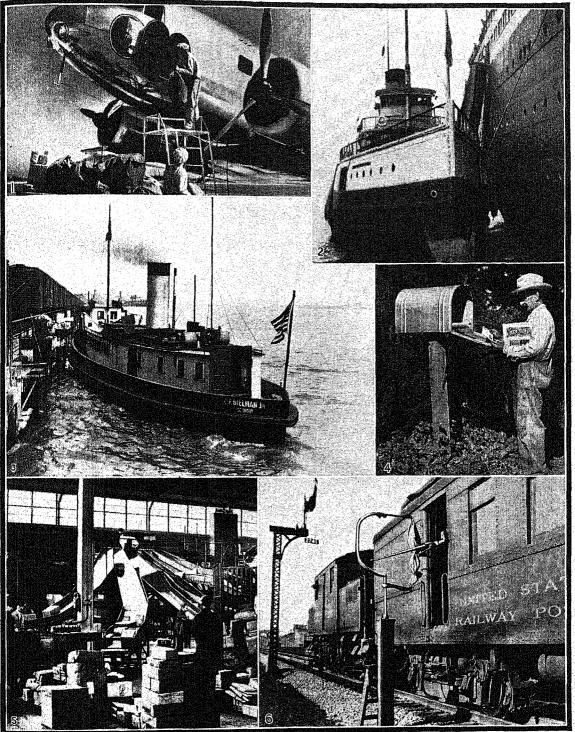
A package has much the same adventures as your letter. It travels by parcel post, which transports goods at much cheaper rates than the express companies. Parcels may be sent collect-on-delivery, and by special delivery, and may be insured against loss.

But not only does the postoffice department transport your letters and packages, but it does a bit of banking for you too—through the money-order division and the postal savings bank. The money-order division is one of the greatest clearing houses in the world. For a few cents money in the form of a postoffice check or draft may be safely sent to almost any point in the world. By means of the international money-order system money is also exchanged between different countries. Two to three billion dollars is transferred every year through the money-order division.

Of scarcely less convenience to the public are the postal savings banks, established in all large post-offices. By these Uncle Sam encourages thrift, helping persons with small earnings to save money. Anyone more than ten years old may begin with a \$1

A veteran Danish carrier, still

AIRPLANE, LINER, AND RAILROAD SPEED THE MAILS



By air, land, and water the postal service of the world is carried on with ever-increasing speed, and with every possible mechanical aid in the handling of mail. 1. The air mail, which comes humming into cities night and day so regularly that it is scarcely noticed, is a great convenience to business in a country so large that the sun itself takes four hours to cross it. 2. Government boats meet incoming Atlantic liners at New York, receive mail from the liner down a chute, and speed it to shore long before the passengers land. 3. A unique floating postoffice is the mail boat which plies the Great Lakes, delivering and receiving

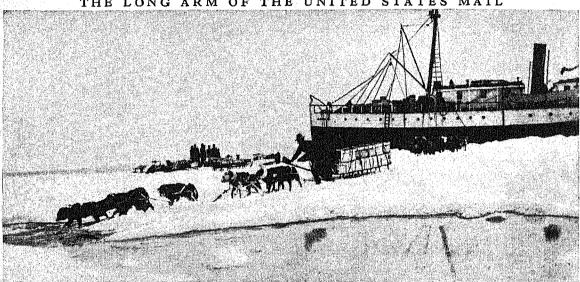
mail for men on board the lake ships. 4. The Rural Free Delivery system is always heartily appreciated by the farmer, who knows how much this service has done to prevent the isolation of the farming population. 5. In this modern postoffice, parcel mail for different parts of the country is separated first by sliding it down various chutes to the proper departments. 6. A hook reaches out of a railway mail car as the train speeds on and automatically hauls in a bag of mail hung on steel arms near the station platform. Thus small villages at which the express trains make no stop have the advantage of fast mail service,

deposit. Annual interest of 2 per cent is allowed. Anyone may purchase war savings stamps and bonds.

Thus you see what a complicated organization Postman Uncle Sam maintains. But it was not achieved without many many years of development. Under the Persian Empire and the Roman Republic, official letters were transmitted by couriers from one end of the realm to the other, but private persons had to trust to chance opportunities for the con-

The beginning of a postal service in North America dates from 1639, when the Massachusetts government designated a Boston man to take care of the delivery and receipt of overseas letters. In 1657 Virginia established a postal service by requiring every planter to convey dispatches, as they arrived, to the next plantation. In 1672 the government of New York colony established "a post to go monthly from New York to Boston."

THE LONG ARM OF THE UNITED STATES MAIL



In many of the remote outposts of Alaska, the mail service is the only regular reminder that Uncle Sam is thinking of his isolated people. Here we see a revenue cutter delivering mail on the edge of the Arctic circle. From the coast, dog sleds carry it to inland settlements across the trackless wilderness of snow.

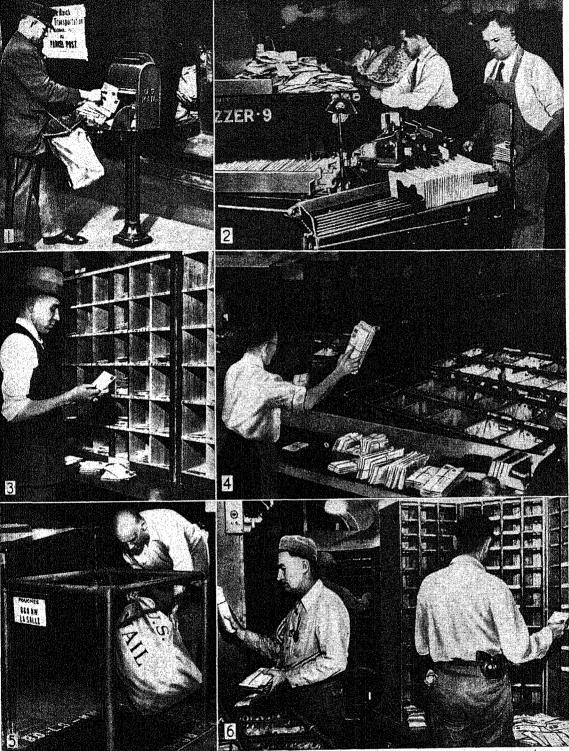
veyance of letters. The first postal system for the use of private persons, apparently, was established under Diocletian at the end of the 3d century A.D. Theodoric the Great, Charlemagne, and other great rulers started well-organized postal services. The University of Paris at about the end of the 13th century established for the use of its students the first postal system in France. A royal courier system established by Louis XI for his own use was continued by his successors, and at last private persons were allowed to use it. The first post in Germany was established by one of the petty German princes in the 15th century; it was extended and made permanent under the emperors Maximilian and Charles V. In Italy the postal system, which began in Piedmont, was at first in the hands of the city states and private persons. After 1561 it was farmed out to a postmaster-general, and from 1710 it was directly under the administration of the separate governments. In England private posts existed from the time of Edward III, and a royal messenger service, out of which the postal service developed, even earlier. A postmaster-general was appointed as early as 1533, in the reign of Henry VIII. The service was extended from time to time, but was not consolidated into one establishment until 1711.

The first general postal system for the colonies began in 1692. A deputy postmaster-general for America was appointed, and by an act of Parliament in 1710 he was directed to keep his principal office in New York" and other chief offices in some convenient place or places in other of Her Majesty's provinces or colonies in America." The system, however, was a comparative failure until Benjamin Franklin was appointed to the office by the British government in 1753. Franklin discharged this duty until 1774 with much ability and efficiency; when he was removed, the net revenue of the department exceeded \$15,000, and the foundation of the present postal system of the United States had been laid.

Even at the close of the American Revolution rates were still very high. The schedule in force for the first half of the 19th century charged six cents for a single sheet of paper going not more than 30 miles (envelopes were still unknown); between 30 and 80 miles, ten cents; and so on up to twenty-five cents for distances over 400 miles. Letters of more than a single sheet were charged double.

In 1837, Rowland Hill, a British educator, published a pamphlet which resulted in the greatest single advance in the history of postal systems. This was the adoption of uniform penny postage and of

HOW THE POSTOFFICE HANDLES LETTERS



1. The mail collector, driving a postoffice truck, gathers the mail from a corner letter box of a big city. 2. At the post-office it is sorted by mail classifications—first class, third class, etc.—and first class letters pass through the machine shown here which cancels the stamps and prints the post-mark on each letter. 3. The letters are now taken to one of the many primary distribution units where they are sorted into cubbyholes by states; the contents of each cubbyhole

then go to the secondary distributing unit for the state in question where the letters are sorted by towns and cities. 4. Tied in bundles they go to a mail-sack distributing unit where a clerk skifully tosses them into sacks destined for various railway mail cars. 5. The sacks go down a chute to trucks which deliver them to the cars. 6. Inside the mail car, after the train starts, the bundles for the larger cities are untied and sorted over again according to the various postal districts of each city.

THE CLASSES OF MAIL MATTER AND POSTAL RATES

First Class. Postal cards, letters, and any matter sealed against inspect	ion:
Out of city delivery (rate per ounce or fraction of an ounce)	3¢
Local delivery having letter carrier service	2¢
Local delivery having postoffice boxes but no carrier service	1c
Postal cards (each)	1¢
To Canada, Newfoundland, Labrador, Spain, and all Latin American countries except the Guianas and British possessions	3¢ 2¢
To other foreign countries (for first ounce)	5¢
For each additional ounce	3¢
Postal cards (each)	3¢
Air Mail. United States, Canada, and Alaska (per ounce) Puerto Rico and Virgin Islands (per ½ ounce) Canal Zone (per ½ ounce) Hawaii (per ½ ounce)	6¢ 10¢ 15¢ 20¢
Second Class. Available only to publishers of newspapers and periodic For bulk shipments fourth-class rates apply. For lesser weights, rate is 1¢ for each 2 ounces or fraction of 2 ounces.	
Third Class. For matter weighing 8 oz. or less, except 1st and 2d class: Merchandise and loose printed matter, for each 2 oz. up to 8 oz	1½¢ 1¢
Fourth Class, or parcel post. All matter except first and second class weight over 8 oz. and up to 70 lbs. The limit of size is 100 inches in length girth combined. Rates vary according to distance; for example, the delivery 7¢ for 1 lb. up to 42¢ for 70 lbs.; 8th zone (over 1,800 mil	and ocal

Books permanently bound and containing no advertising except incidental announcements of other books (per lb. regardless of distance) 3¢

Single catalogs and similar printed advertising matter, individually addressed, with 24 or more bound pages and not exceeding 10 lbs.: 4¢ to 10¢ per lb. according to distance, and ½¢ to 7¢ for each additional lb.

the adhesive postage stamp in 1839-40. Before his time postage was paid in money by either the sender or the receiver, and the rate varied with the distance as well as the weight, so that a letter within the limits of England often cost as much as a shilling (25 cents) postage. The chief features of the reform were the uniform rate irrespective of the distance, and the reduction to one penny (two cents). The chief purpose of the postage stamp was to make prepayment easy; double postage was collected on letters not prepaid. The introduction of the postage stamp also made possible the use of pillar letter boxes, first introduced (in London) in 1855.

Other Landmarks in Postal History

The success of these reforms led the United States to lower postal rates in 1845, and to introduce postage stamps in 1847. Other important landmarks were the establishment of the dead-letter office (1825); the introduction of stamped envelopes (1852); of the free delivery, railway mail car, and the money-order system (1863–64); of postal cards (1873); of the special

delivery (1885); of the rural free delivery (1896); of the parcel post service (1912). Coin-operated public letter boxes known as "mailomats" were introduced in 1939, providing 24-hour automatic postage service. The customer drops a coin in a slot, inserts his letter, and the machine stamps and postmarks it, and deposits it in a mail box for collection.

The postoffice department is one of the ten executive departments of the United States government. Its director, the postmaster general, is a member of the president's cabinet.

Postoffices in the United States are divided into four classes. First class postoffices are those whose annual revenue exceeds \$40,000; second class those whose revenue is from \$8,000 to \$40,000; third class, from \$1,500 to \$8,000; and fourth class, less than \$1,500. Three-fourths of all postoffices in the country are in the fourth class.

Growth of Air-Mail Service

Its air-mail service has helped to make the United States the greatest flying nation in the world. Government subsidies enabled commercial air lines to develop rapid and efficient mail service. The first delivery of air mail was made on Sept. 23, 1911, from Garden City to Mineola, N. Y. The real start of the service, however, came in 1918,

with the inauguration of regular air-mail delivery between Washington, D. C., and New York City. Two years later the first transcontinental service began, and regular night service started in 1923. Transatlantic service on regular schedules began in June 1939, but was interrupted a few months later by the second World War.

Communities without an airport may receive air mail by means of the nonstop pick-up service inaugurated in 1939. The outgoing mail pouch is suspended on a rope swung between two posts erected in any field large enough and free from obstacles. The plane swoops down, drops the incoming mail, snatches up the outgoing with a grappling hook on a trailing cable and draws it up into the plane.

To conserve cargo space during the second World War letters were photographed on microfilm and sent abroad by airplane. At the receiving point special machines printed and enlarged the film and enclosed the letters in envelopes to be delivered like any other letter. In the United States this service was called V-mail; in Canada and Great Britain it was known as Airgraph.

The Universal Postal Union

Among nations, uniformity in rates of postage, transmission, and delivery of mail is attained by means of the Universal Postal Union, founded at Bern, Switzerland, in 1874. Practically every country in the world belongs to it. The Union's central bureau is at Bern, and at intervals. usually every five years, it holds an international congress for the revision of postal regulations. Various regional postal unions provide preferential rates, such as those between the members of the British Empire. The Postal Union of the Americas and Spain, founded in Madrid in 1920, comprises the United States, Canada, Newfoundland, and Labrador, Spain and its possessions, and all the Latin American countries except the Guianas and the British colonies.

The Canadian postoffice system is organized on the same plan as that of the United States. There is a dominion postoffice department administered by a postmaster general. The cities have free delivery. Rural delivery, begun in 1908, has developed rapidly, despite the difficulties of serving a vast territory thinly populated.

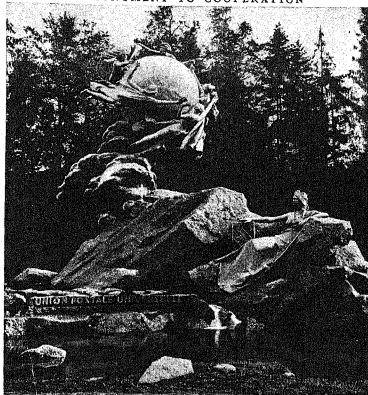
There was a postal system in England in the days of Henry VIII, and the present British system is the outgrowth of it. All European countries have modeled their postal services after that of the British. (See also Communication; Stamp; Transportation.)

POTASSIUM. Man could get along without silver or gold, but without potassium, life, whether of plants or animals, would be impossible. Yet this element is never found alone, and to wrest it from its compounds in paying amounts is a difficult task. No one had ever seen this metal until, in 1807, Sir Humphry Davy obtained it from fused potash by electrolysis.

Potassium belongs to the group of alkali metals which includes sodium, lithium, and the rarer rubidium and cesium. All these form compounds so readily that in the laboratory they are kept under oil to exclude moisture and oxygen (see Alkali Metals). When potassium comes in contact with water it reacts violently, seizes the oxygen and part of the hydrogen to form potassium hydroxide, and generates so much heat that the left-over hydrogen bursts into flame, and in burning becomes water again. Potassium is one of the few common elements which are radioactive. (See Radium and Radioactivity.)

The original source of the caustic potash used in making glass and soap was the lye produced from

A MONUMENT TO COOPERATION



This magnificent group at Bern commemorates the formation of the Universal Postal Union in that Swiss city in 1874. The figures represent the continents clasping hands around the globe, to symbolize the international fellowship which prompts nations to offer their mail facilities to the peoples of other nations.

plant ashes, boiled in a pot, hence the name "pot-ash"; but the world needs vastly more for use as fertilizer than could be produced in this way. The United States alone uses more than 1,000,000 tons of potash salts every year. In raising such crops as cotton, tobacco, sugar cane, and potatoes, potash compounds are especially valuable; in fact, practically all plants use more or less potash, which increases their size and vigor. Although potash compounds are plentiful in nature, most of the potassium is locked up in insoluble silicates in the rocks. The "weathering out" process gradually releases them into the soil, but at a rate too slow to meet agricultural needs. So the supply must be artificially increased.

With the exception of the silicates, most naturally occurring potassium compounds are soluble in water. Rains dissolve them from the soil, and rivers carry them into the sea. There they are so diluted and mixed with other salts that separation is not feasible. Sometimes, however, the potassium salts emptied by streams into lakes have become so concentrated due to the drying up of the lakes that the salts can be profitably recovered. Searles "Lake" in California is a great deposit of dazzling white crystals, impregnated with brine. This remnant of an inland sea contains about 12 square miles of salts 60 to 70 feet deep.

Other lakes, much larger than Searles, evaporated in earlier geologic ages, and left beds of crystallized potassium salts. These deposits, sealed under layers of silt 1,000 feet thick and thus protected from rain, were later uplifted, and the silt hardened into rock. To find the potash, deep holes are bored with core drills down through the rock.

The first of these subterranean deposits was found in Germany, and the numerous mines developed there

supplied the demand for many years. During the World War it was suddenly realized that these potash beds at Stassfurt were the chief source of the world's supply. The United States faced a potash famine. Factories were hastily built to extract potash from the mineral alunite, found in Utah; from volcanic lava, leucite, found in Wyoming; from potash shales in Georgia, and greensand in New Jersey; from brines of salt lakes and marshes in Nebraska, Utah, and California; from seaweeds or kelp on the Pacific coast: and from trade wastes, such as cement kiln dust and the residue from alcohol distillation. Most of these plants were forced out of business when the cheaper foreign potash again came into the market.

Production from Searles Lake brine continued, however, and in 1931 a new source of supply was developed in New Mexico from deposits a thousand feet below the surface. New Mexico and California were soon furnishing

a third or more of all the potash used in the United States. The chief foreign producers are Germany, France, Spain, Russia, Poland, and Palestine.

Potassium nitrate (KNOs), now used in increasing amounts as a plant food supplying both potash and nitrogen, is valuable also in the manufacture of gunpowder. The chloride (KCl) is employed in preparing other potassium salts, and for artificial fertilizers. Caustic potash, or potassium hydroxide (KOH), is used chiefly in making soft soap. Potassium chlorate (KClO3), an effective source of oxygen, goes into fireworks, flashlight powder, safety matches, dyes, and explosives. The bromide (KBr) and the iodide (KI) are used in photography and medicine. Potassium cyanide (KCN) is a valuable agent for extracting gold from low-grade ores, and a source of hydrocyanic acid gas, or "prussic acid," a deadly poison used in fumigating. The carbonate of potassium (K2CO3) enters chiefly into the manufacture of hard glass and soap. The metal is generally prepared by electrolysis of fused caustic potash. (See Fertilizers; Sodium.)/

POTATO. When Spanish adventurers first reached the Pacific coast of South America, they found the natives of the Andes cultivating the tubers from which our potatoes have been developed. No one knows who first took the potato to Europe, but it seems to have been known in Spain by about 1570, and in England before 1590. In Europe potatoes were cultivated merely as a curiosity for many years before they were accepted as a food. They were not grown in the United States until 1621, when they were brought in from Bermuda.

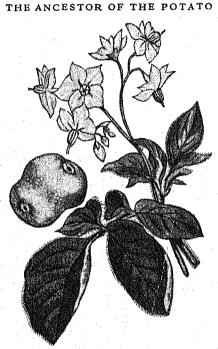
Never did the Spanish adventurers dream that those insignificant tubers would prove a greater boon to the world than all the gold and silver of America. The

potato as developed by cultivation is one of the most prolific of food plants, producing more food peracrethan any other cron. Yields of 200 to 300 bushels an acre are common, with fertilizers, and record yields of over 1.000 bushels an acre have been produced in California and Colorado. The potato is widely grown, maturing farther north and at higher altitudes than any other important food crop except barley. Today the value of the annual crop of more than 6,000,-000,000 bushels far exceeds that of the annual production of gold and silver. About nine-tenths of the world's crop is grown in Europe, because it meets the demands of the crowded continent both as a human food and as stock food. Germany produces about one-fourth of the total. Poland, France, Switzerland, Holland, Belgium, Denmark, Norway, Sweden, and Russia also are heavy growers and consumers.

The cultivation of the potato has played an important part

in the history of Europe. In certain parts of Germany it helped to check the famines caused by the Thirty Years' War. By 1688 it had become the staple food of the Irish peasantry, and the failure of the potato crop in 1845 and the resulting famine started the first great wave of Irish immigration to the United States. But in many places the introduction of this new food encountered prejudice and misrepresentation, for it was ignorantly said to be the cause of leprosy and many sorts of fevers. A learned Frenchman named Antoine Parmentier did much to dispel such prejudice through a series of books and pamphlets (1773-89) in which he urged its cultivation and use in France; and the French king Louis XVI wore the flowers of the plant in his buttonhole to popularize it. Frederick the Great of Prussia also championed the potato's cause.

The potato is about three-fourths water, the remainder being starch, with small amounts of protein and fats. The proteins are in a layer next to the skin and may all be wasted by deep paring. The potato



From the wild Solanum tuberosum all cultivated varieties of the potato are descended. The cultivated potato looks very much the same, except that the tuber is larger.

therefore retains more of its food value when cooked with the skin on. Since it contains a large amount of starch, or carbohydrate, it is valued chiefly as an energy food. It also supplies vitamin C.

Of the many products made from potatoes, the most important are starch, flour, sizing, alcohol, and cattle feeds. In Europe alcohol from potatoes is extensively used for blending with gasoline to make motor fuel.

The white, or "Irish," potato (Solanum tuberosum) is a member of the nightshade family (Solanaceae), which also gives us tobacco, poisons such as belladonna, foods

such as the tomato, and flowers such as the petunia. The tuber, the part we eat, is an underground stem in which the plant stores up nutriment.

The small purplish or white wheel-shaped flower of the plant develops into a soft green berry full of seed. This seed is used only by seedmen who hope to discover new varieties as Burbank did when he

HOW POTATOES ARE PLANTED ON A MODERN FARM



This machine fertilizes and plants two rows of potatoes at once. It opens furrows for fertilizer on both sides of each row, and drops the fertilizer from the front hoppers. Nozt it outs a trench between the fertilizer bands for the potatoes which fall from the back hoppers. The rear disks then close the furrows.

developed the potato which bears his name. There are now perhaps a thousand established varieties. At the time of the American Revolution, there were only two, the red and the white.

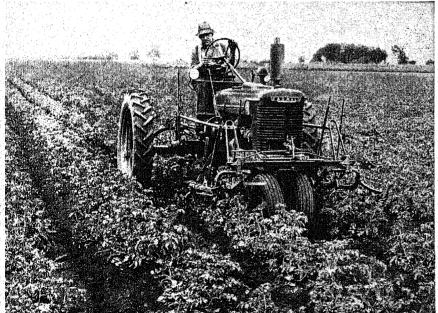
In growing potatoes, the best tubers should be chosen as seed. The two leading certified-seed producing states are Maine and North Dakota. The

seed potatoes are cut into pieces about the size of an egg, each containing one or more eyes. The new plants grow from the eyes.

The pieces should be planted in a friable soil that has been well fertilized. The field should be thoroughly worked before planting, and cultivated frequently afterward to aerate the soil, conserve the moisture, and keep the weeds down. When the tops become large enough to shade the ground, cultivation should be kept shallow so as not to cut the roots, which spread out between the rows.

Growing potatoes for the early northern market is a large business in Southern states and

CULTIVATING A POTATO FIELD WITH A TRACTOR



Potatoes must be cultivated often to keep the weeds down. When the tops are as large as those shown here, cultivation should be shallow so that the roots are not disturbed. This farmer with his two-row tractor can work about 30 acres a day.

the Bermudas; but potatoes flourish best in climates which are just too cool for corn. There is a belt of 120,000,000 acres running from Newfoundland, maritime Canada, and New England, through New York, Pennsylvania, and the American and Canadian Lake region, and by way of the Yukon valley almost into the Arctic Circle, where potatoes have been found amazingly productive. The giant Idaho and Montana potatoes which often weigh several pounds are favorites for baking.

The sweet potato (Ipomoea batatas), although it also is a native of tropical America, belongs to a totally different botanical order from the white potato (see Sweet Potato).

POTATO-BUG. Civilization is responsible for the bad habits of this member of the beetle family. Five years before the Civil War, this insect was a harmless denizen of the western plains, where it fed on a weed called the sand-bur or buffalo bur. Its only name in those days was its scientific one, Dorophora decemlineata, the absence of a common name proving that it had never bothered anyone very much.

Unfortunately, the sand-bur was a sort of "country cousin" of the potato, and when the pioneer farmers of the West began planting potatoes, Dorophora discovered that the potato plant had a far more delicate flavor than its wild relative. Abandoning the sand-bur of the dry plains, the insect invaded fields and gardens. The new food agreed with it so that it multiplied with startling rapidity, soon winning the title of "potato-bug" or, more properly, "Colorado potato beetle."

Vast armies of these beetles began an eastward march. In 1859 they had reached Nebraska; in 1861 they were in Iowa; they crossed Iowa in four years; and jumped the Mississippi River in 1865. "They passed through Illinois," said one scientific observer, "traveling in many separate columns, just as Sherman marched to the sea."

By 1874 the potato beetle had reached the Atlantic seaboard, spreading north into Canada and south through Virginia. Today its territory includes all the United States east of the Rockies, with the exception of narrow strips along the Gulf of Mexico. It also found its way to Europe.

The adult potato-bug is a yellowish-brown beetle about three-eighths of an inch long and one-quarter of an inch wide, with ten black stripes running lengthwise down its high rounded back. It spends the winter in the ground, coming out at the first thaw and waiting for the appearance of the first potato sprouts, which it attacks with starving appetite. It begins to lay its orange-colored eggs almost immediately, on the under side of the young leaves. They hatch in about a week, producing dark red larvae or "slugs" of a shiny and disgusting appearance, which begin at once to devour the leaves at a great rate. In about 20 days the larvae reach full size, enter the pupa stage in the ground, and emerge as adult beetles about two weeks later. As each female lays 1,000 eggs or more and there are from two to three generations a summer, it is easy to see how the potato-bugs reach such enormous numbers. When potato plants are not available, they will often attack tomato plants, egg-plant, or even tobacco.

With proper care, the ravages of potato-bugs are not hard to check. Formerly these beetles and their slugs were picked or brushed off the vines by hand, but today the system of spraying the leaves with paris green or some other arsenic compound has proved the most rapid and effective way.

Just as the potato-bugs learned to eat potato vines, so many insects, birds, and other animals have learned to eat the potato-bug, since it migrated from the West. Certain species of lady-bugs devour the eggs and the young larvae in large numbers; while ground beetles, tiger-beetles, soldier bugs, robberflies, and spiders also give man assistance in the battle. The chief bird enemies of the potato-bug are the grosbeaks, quail, robins, crows, grouse, and thrushes. The name "potato-bug" is sometimes applied also to a three-striped leaf beetle, and to certain blister beetles which occasionally do great damage to potato crops.

POTO'MAC RIVER. Placid and deliberate, bearing fortunes in weighty commodities—naval ordnance, building and paving stones, sand and gravel, oils and ice—the broad Potomac from Washington to Chesapeake Bay forgets its birth in the mountains. Perhaps too it forgets the old days when the white men first came—Capt. John Smith seeking a passage to the South Sea; later, merchant vessels from London bearing goods and gauds of all kinds to offer Virginia and Maryland planters for the strange new-fangled commodity, tobacco; still later, the great barge of young Mr. George Washington putting out from the Virginia shore to visit the Calverts in Maryland; and then all the tragedy of the war between North and South, whose boundary line was the same river.

From its sources in the Alleghenies of Virginia and West Virginia to its mouth, the Potomac is about 450 miles long and for nearly its whole course a boundary between Maryland and West Virginia and Virginia. Its two branches, the north and the south, unite in Hampshire County, W. Va. From this junction to its mouth the river is 287 miles long. At Harpers Ferry the Shenandoah joins it in breaking a splendid gorge through the Blue Ridge. Later its other important tributary, the Monocacy, flows in from the Maryland side, Lower down, at the Great Falls, it tumbles over a six-staged terrace, once one of the wonders of America before Niagara Falls was easy to reach. The head of navigation is at Little Falls. At Washington, three and one-half miles farther down, the river is a mile wide, with a channel 20 feet deep. It is over seven miles wide where it enters Chesapeake Bay. Georgetown, D.C., and Alexandria, Va., are after Washington the most important cities on its banks. Washington's home and tomb at Mount Vernon and the national cemetery at Arlington are among the places of interest along the river.

POTTERY as an INDUSTRY and a FINE ART







hrower," or potter working with a simple hand wheel, throws a lump of clay on the revolving wheel, shapes the vase with his hands, smooths the inside with a wet sponge, and finishes the top with a lip. This process is used for fine ware.

POTTERY AND PORCELAIN. The art of the potter gives us not only most of our dishes, bowls, vases, and many exquisite ornamental pieces, but also much of our useful material for building construction, such as brick and tile. Long before the beginnings of recorded history, primitive peoples learned to shape useful articles out of clay and bake them until they were hard. When they made this discovery, they took a long step in the slow advance to civilization. Archeologists find the long-buried pottery remains of various peoples one of the most useful sources of information about the various cultures of prehistoric times (see Archeology; Civilization).

In the broad sense, "pottery" and "ceramic ware" are terms for all baked clay objects—from the coarsest

brick and sewer pipe to the finest porcelain-and the term "ceramics" is applied to all such products and to the industry and art of making them. The term "pottery" is often used in a narrower sense to include only earthenware, stoneware, and porcelain. Some primitive peo-ples make pottery by shaping the clay into a rope, coiling it to form a vessel, and then smoothing it into proper shape, as this African woman of frican woman Fumban is doing.

"Earthenware" generally means a coarse, heavy, opaque, porous pottery; in recent years it has been applied to a very durable dinnerware made in the United States. Stoneware contains more silica (see Silica) so that the body of the ware after firing becomes glassy throughout and impervious to water. Porcelain is any fine grade of ware that is vitreous (glassy) and translucent; this is also called "china."

There are many kinds of clays and glazes, and upon the fineness of the materials used depends the grade of pottery produced. Most pottery is made of a mixture of clays, with the addition of feldspar, quartz, and flint. Ball clay is white or nearly white and gives strength and plasticity. In the United States it is produced chiefly in Kentucky and Tennessee, though some is imported from England. Stoneware clay is a coarser clay used in yellow ware and art ware chiefly from Ohio, Illinois, and New Jersey. Kaolin (also called china clay) is a fine white clay used in making porcelain. It is produced mostly in Florida and North Carolina, although a small amount of it is imported from England. (See Clay.)

The chief steps in pottery making are mixing, shaping, firing, glazing, and decorating. Frequently pottery is fired several times, especially in glazing and decorating. The solids are mixed with water in large vats called "blungers," or in pebble mills. The creamy liquid clay, called "slip," is then filtered through "lawns," or strainers, of either cloth or metal, to screen out coarse particles; and magnets extract any iron that might be present and discolor the pottery.

Next the liquid slip is converted into a thick heavy mass by pressing out the water. Some methods eliminate this step by the use of materials which produce a smooth, slow-moving mixture without pressing. In the pressing method, the slip is pumped to filter presses, which squeeze out the water and leave the clay mixture in the form of round cakes. Sometimes these cakes are stored in damp cellars for weeks or months; but in most modern factories the aging time is reduced, or even eliminated, by putting in the

The cup is then put on

RID AMPRILIE

mixture large amounts of ball clay. Long aging is essential for making the finest porcelains. In China, it is said, one generation prepares slip for the next. When it is ready for use the clay is squeezed through machines called pug mills. These have knives which cut up and compress the clay, forcing it out through a nozzle in a continuous soft round column.

REFINING AND STORING THE CLAY

a lathe and finished with a tool.

In casting, a plaster-of-paris mold, made in sections, is filled with liquid slip; and as the mold absorbs the water in the slip a film of clay is deposited on the sides of the mold. The mold is then carefully stripped off. This process is used for "egg-shell"

process is reversed: the mold shapes the outside and

the jigger forms the inside.

off. This process is used for "egg-shell" china and for fine ornamental ware.

Firing, Decorating, and Glazing

When the pottery has been shaped, it is called "green" ware. The articles are then put in boxes of fire clay, called "saggars," or if they are delicate, in separate containers, and placed in a kiln for the first, or "biscuit" firing. The degree of heat varies with the type



In some potteries the clay is first mixed with water and refined before it is mixed with the other materials. At the right of the upper picture you see the clay passing through a channel into a distributing cistern. There it passes through a fine screen before being deposited in the settling pits. When the clay is dry enough, it is cut into cakes and stored until needed, in the shed shown in the lower picture.

Pottery is usually shaped today in one of three ways: throwing, molding, and casting. Before the invention of the potters' wheel, which is used in the throwing process, pottery was shaped by hand, as it still is by

some peoples. The potters' wheel, the most important invention in the history of pottery, is simply a revolving circular table, or "wheel," upon which the potter (or "thrower," as he is called) throws a lump of prepared clay. As the wheel spins around, he models the clay with moistened fingers or tools into the shape of plate, jug, cup, or other vessel. After the article has been removed from the wheel, it is usually placed on a lathe, and perfected with sharp tools. "Throwing" is now used chiefly for fine art ware and for porcelain.

Molding and Casting Pottery

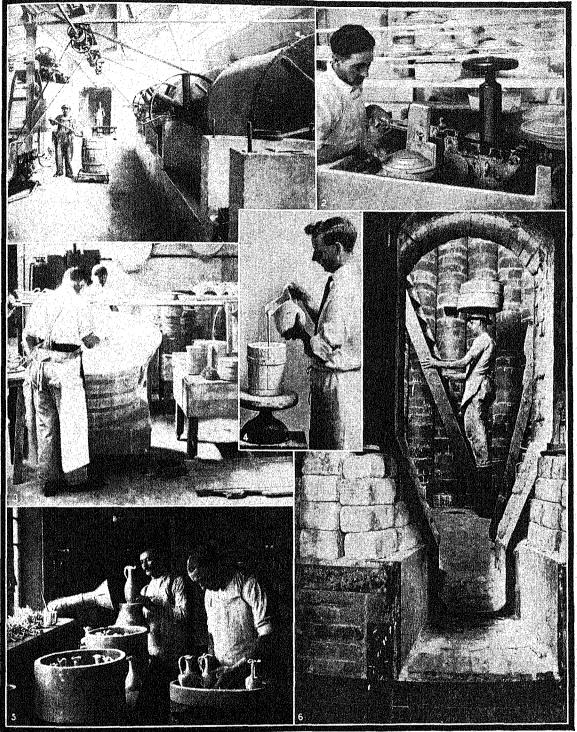
In both the molding and the casting processes a plaster-of-paris mold gives shape either to the inside or the outside of the ware. In the molding of flatware, such as plates and saucers, the mold fashions the inside, and a machine called a "jigger" forms the outside. This machine consists of an arm pivoted on a post. On the end of the arm is a steel profile exactly the shape of the bottom of the plate from center to edge. A flattened piece of clay called a "bat" is put on the mold, which is on a revolving head. The arm of the jigger is so adjusted that the profile can be pulled down just far enough to cover the revolving mold and give the desired thickness and form to the outside, or bottom, of the article. In making cups the

of ware, rising to more than 2,000° F, for some kinds. After about three days the ware is ready to be removed. The old beehive kiln has been replaced in many potteries by the tunnel kiln, 300 to 500 feet long, through which the ware passes on moving cars as it is fired.

Glazing and decorating are closely related processes. After the first firing, the ware is dipped in a liquid glaze, composed of such materials as melted feldspar, kaolin, ground quartz, boric acid, and lead oxide. The pottery is then baked again until the glaze is fused and covers the articles with a hard, glassy, liquid-proof coating. Some stoneware is fired only once, receiving its glaze from salt thrown into the saggars as they cool. Colored glazes are produced by adding metallic oxides, such as chromium for green, cobalt for blue, and manganese for black.

Decoration may be either "underglaze" or "overglaze." Underglaze decoration is applied to the unglazed ware, which is then given a light firing to fix the colors. After this, the decorated piece is glazed and fired in the usual way. Decoration protected by the glaze is very durable. Its disadvantage is that some colors melt under the high temperature necessary to fix the glaze. In overglaze decoration, the colors are

HOW CLAY IS TURNED INTO CUPS AND SAUCERS



1. For some fine wares the clay and other materials, after being carefully weighed out according to formula, are ground for hours in "pebble milis" like these. The cylinders contain water and flint pebbles, which convert the ingredients into a thick creamy mass called "slip." 2. The slip goes to the operator of a "jiggering" machine, which is the old potters' wheel spun by electric motor. On it the worker shapes plates, cups, and bowls. 3. After the shaped or molded pieces have been dried and baked once, they are dipped in a glaze, to give a hard, glassy surface. Expert glaze-dippers slip them in and out of the bath so quickly that

the work goes like magic. Yet the thickness of the glaze must be absolutely uniform or the piece will crack in the "glost" kin where it is baked to fuse the glaze. 4. For a more elaborate piece, the slip is not shaped on the "jigger" but is poured into molds, which shape the piece one-fifth larger than it is wanted, to allow for firing later. Handles, spouts, and knobs are molded and affixed by hand to bowls and cups. 5. For each firing, the pieces are put in earthenware pans, called "saggars," and (6) balanced calmly on the heads of workmen who carry them to the kiln where they are stacked to be fired at a high temperature.

applied to the surface of the already once-baked glazed ware and then fixed into the surface of the glaze by a second firing at a relatively low temperature. The variety of colors which can be used in overglaze is almost unlimited. The rich iridescent finish of "lusterware" is produced by a mixture of certain metallic salts, which is painted and fired upon the glazed surface.

Decorations can be put on by hand with a brush, by stamps, or by transfers. In the transfer, or "decalprocess colored tissue-paper patterns are comania," applied to the unglazed ware. When the tissue is

soaked off, the design remains.

The process of making porcelain was guarded as a secret by the Chinese for many centuries. Although they may have learned how to make porcelain as early as the 3d century A.D., the earliest specimens yet discovered were made in the 9th century. True, or hard-paste porcelain, is made of kaolin and powdered feldspar, called by the Chinese petuntse, and by the English "cornish stone" (see Feldspar). Quartz or sand is often used as well. Kaolin does not melt; feldspar melts only at high temperatures. When the melted feldspar cools, it holds the white kaolin in suspension, and thus gives the resulting porcelain its translucent texture. Early European imitations, called "soft-paste" or artificial porcelains, were made of clay and glass. Beautiful wares were made of softpaste porcelain but they lacked the remarkable refractory quality of hard-paste porcelain and were less durable. A third variety, intermediate between the "hard" and the "soft" varieties, is English "bone porcelain" which is remarkably resistant to breakage

Historic Types of Pottery The first earthenware was roughly shaped by the hands alone and lightly baked against an open fire. Then the use of the potters' wheel and a primitive form of kiln opened the way to improvement of both form and utility. Before methods of glazing were discovered, pots and other articles were decorated by scratching with a pointed stick or by shaping with the fingers as the wet clay was handled. With the intro-

duction of glazing, earthenware became less porous. Every people and every age has had its own peculiar types of pottery, differing in form and design. Egyptian pottery is famous for the beauty of its colored glaze rather than for perfection of form. The people of Egypt and Mesopotamia used copper in making beautiful turquoise-blue glazes, as we know from the bottles and jars taken from Egyptian tombs and ruins of Mesopotamian palaces. They also excelled in making glazed tiles which were used to cover walls with decorative designs.

The world's most beautiful pottery for form and decoration was that made by the Greeks. Their typical form, the vase, had many shapes and uses. Vases were used as measures, for storage of food, as prizes in athletic contests, and for religious ceremonials. In the classic period, from about 600 to 400 B.C., three colors were chiefly used-brick-red, black, and buff. Usually the red and the buff were the natural colors of the clay, and the black was laid on as a thin glaze, which gave a lustrous non-reflecting surface of much beauty. The decorations—human figures. animals, and geometrical designs—were in earlier times usually painted in black on the natural red or yellow ground. Later it was the fashion to leave the figures in red, and paint the background in black.

Another form of the Greek potter's art is the famous and delightfully modeled Tanagra terra cotta figurines, named from the city where many of the finest specimens were found. These colored statuettes range from about 9 to 20 inches in height and generally

depict scenes from mythology.

The best work in Greek pottery was done in the 5th century B.C. in the Age of Pericles, when Greek civilization was at its height (see Greece). Then designs, figures, and groups of figures depicting scenes from the lives of the gods and men were fitted to the curved surfaces with a perfection that has never again been attained. Greek vase making and Greek vase painting at their best constitute one of the most splendid achievements of art. The Romans were largely influenced in their art of pottery by Greek craftsmen. though they never approached them in the quality of their work or originality of design.

The Great Art of the Chinese

It is remarkable that the superb work of the Greek vase makers did not exert a greater influence on the art of pottery in other parts of the world. Chinese pottery, especially porcelain, however, had a wide effect, which was first felt by Asiatic potters and later became the inspiration of European artists.

A kind of decoration peculiar to Chinese pottery at a very early date is known as "crackle." It is usually of a brownish-cream color, and often decorated with embossed small circular ornaments in dark brown. It is produced by several methods, frequently by making the body of the ware more sensitive to heat and expansion than the coating or glaze. Another very early ornamentation, the "flashed" or "agate," imitates the surface of agate. "Celadon" ware made in the Sung dynasty, 960-1272 A.D., has a muchprized, peculiarly beautiful, pale green tint. From the 12th to the end of the 18th century, much "pure white" Chinese porcelain, usually undecorated, was manufactured.

Perhaps the most beautiful Chinese porcelain is the "blue and white," which was very popular beginning with the 14th century. At first the blue was a pale gray-blue; later it was a dark blue of marvelous depth and luster. The decorations include many kinds of subjects-landscapes, battles, hunting scenes, games, leaf forms, symbols of luck, long life, and riches, and recognizable objects, such as a bundle of books, a brush, a cylinder, an inkwell. The blue and white was often called "old Nanking," or "Nanking," from the port from which much of it was shipped.

Other well-known Chinese porcelains are the famille verte, in which the prevailing colors of the ground

glaze are shades of green; famille jaune, a pale yellow: famille noire, a brilliant black with a wash of green. difficult to detect, which is singularly effective; and famille rose, in which pink or rose color prevails. These are all decorated with great care, often profusely; and not infrequently the design, a spray of fruit bloom or a peony flower, is enameled in delicate relief.

Japanese pottery was strongly influenced by the Chinese. In the 13th century artistically significant work in stoneware and earthenware was started. Later, reproductions of the famous Chinese Nanking blue and white porcelain were highly successful. The "Satsuma" porcelain with a remarkably fine crackle and a glaze in ivory tones is a famous product.

Potters of the Saracen Countries

Persia inherited the skill in glazing which marked the wonderful tiles of early Mesopotamia and, like the Chinese, aimed at a pure white ware. From the 12th to the 16th centuries, Per-

sian pottery shows brilliant and harmonious coloring in the forms of animals, flowers, and inscriptions.

The name "Saracen" is given to all wares made in the lands conquered by the followers of Mohammed from the 7th century on. The most famous development was in Spain under the Moors. From 1300 on, Hispano-Moresque ware became famous for its intricate geometrical patterns on tin-enameled earthenware.

Such tin-enameled ware has special qualities of texture and surface that make it admirably suitable for painted decoration. The art originated in the Near East and spread to Spain, Italy, and at length to France and other parts of northern Europe. In Italy it was called maiolica from the island of Majorca, probably because the Italians got their first specimens of it from Majorcan trading vessels. In northern Europe it was called "delft," from the Dutch town in which this pottery reached its highest development. Maiolica was also made in England.

In Italy the period of maiolica ware began at the opening of the 16th century. This costly ware was popular because of the variety of its forms and the richness of coloring in the painted decorations coupled with figure compositions, and even portraits.

More than 50 Italian towns produced pottery in the middle of the 16th century. The principal factories were at Faenza, Cafaggiolo, Deruta, Gubbio, Pessaro, Urbino, and Castel-Durante. Faenza was the most important town that produced much earthenware, and its widespread commerce caused the name of the town to become a trade name, "faience," as a designation for every kind of white ware that was not porcelain. Each center of production developed some characteristic of its own:

Faenza.—Vigorous colors and strong outlines. Figures almost archaic; severe compartments of banded ornamenta-

Coloring intense blue, tion. black, and saffron vellow.

Urbino.-Fanciful arabesque, imitated from the antique known as "grotesque": delicate traceries that left the white ground to play an important part in the light coloring (pale blue, green, grays, and light purple); double glazing and golden lusters. Decoration of masks in relief or twisted serpent handles and painted picturesque mythological compositions against elahorate backgrounds of landscape and buildings.

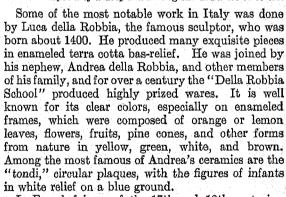
Deruta.-Copied Hispano-Moresque ware. Never had any marks. Noted for chamoiscolor luster.

Gubbio .-

-Nacreous and brassy many-colored luster of rainbow effect. Ruby color decisive. All pieces marked.

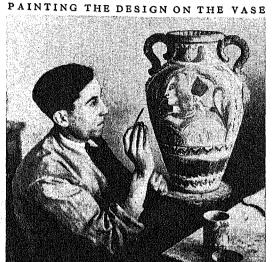
Cafaggiolo .- Patterns of bands of running scrolls, arabesques, and geometric compart-

ments filled with fish scales and peacock feathers adapted from Faenza. Specialty a deep red among the usual set of colors.



In French faience of the 17th and 18th centuries. Rouen holds the first place. Its potters made earthenware not only in Chinese and Italian styles, but closely imitated the Dutch delft style. Popular types of polychrome decoration were the "horn of plenty" and quivers, torches, and coats of arms. The general colors were lemon-yellow, brick-red, blue, and green.

About the middle of the 16th century Bernard Palissy, a potter at Saintes, France, introduced new methods which made his name famous in the history of pottery making. Attracted by a splendid white enameled vase, he determined to discover the secret of its beauty. This he failed to do, but, after years of labor and poverty, during which he even used his



With careful touch this young artist of Florence, Italy, is tracing an ancient Florentine design on a big amphora before it goes to the firing kiln for baking.

furniture to fire the kiln, he did find ways of making colored lead glazes. The earthenware body he used was a reddish-yellow tinted white with lead glazes. The decorations on his large dishes and ewers were cast in relief; animals, reptiles, flowers, and fish were

grouped over the entire surface of his ware. His colored glazes are highly translucent and are both soft and brilliant, never shiny, as they became in the hands of his numerous imitators.

A fine stoneware for jugs and tankards, with a ground color of gray, and interesting decorations in various colors, known as "Rhenish stoneware" or "Cologne ware," was made in the German Rhineland in the 16th century. Molded on the stoneware is a world of pictorial representations, together with mottoes and proverbs. They were not made as show pieces but as household goods. All the shapes are original and were created independently of all other pottery, constituting a unique artistic achievement.

The Dutch, too, played an important part in the history of pottery. As traders with China, they brought to Europe large shipments of Chinese ware. In the 17th century they began to copy it, and produced the famous blue and white imitation known as "delft," from the name of the Dutch city in which it was made. Earthenware dishes now began to replace those of wood and pewter even in the humble homes. At its best, delft is a near rival of some of the finest Chinese blue and white, which seems to have been an inspiration both in tints, paste, and patterns for the Dutch artists.

True porcelain was first made in Europe in 1709, when Johann Friedrich Boettger used kaolin from deposits near Dresden. In the following year, he started the famous factory at Meissen, near Dresden, and "Dresden china" was put on the market. In the same century the equally famous factory at Sèvres in France was established.

Those two factories fixed the fashions in European fine wares, and their lead is still acknowledged. For refined shape, with classical restraint, and for decorations in extraordinarily beautiful colors, these wares are unsurpassed.

In England the manufacture of porcelain on European lines was begun about 1750 at Bow, Chelsea,

od fish were uct was harder



Perhaps 20 centuries B.C. the painted vase at the top was made at Cnossus in Crete. The drinking cup, or kylix, in the center, in red on black, shows Artemis with a torch, and is ascribed to Douris of Athens, a noted artist in the red-figured style. It is dated about 450 B.C. The water jar, or hydria, below, shows a git embracing a victorious athlete; dated 480-460 B.C. The two lower vases are in the Art Institute of Chicago.

Worcester, Bristol, and many other places. Their product, known as "bone porcelain," an invention of that period, gained a distinctive translucency by the addition of bone ash to the porcelain paste. The product was harder than soft-paste porcelain, but not as

hard as true porcelain. The Chelsea potteries first designed the "Chelsea figures," which later were made also in other places. From other potteries came delightful table services for dinner and tea, many of which were imported into America before the Revolution. These wares -"Leeds," "Liverpool," "Swansea," and many others-are now much sought by collectors. The greatest development in pottery making was in Staffordshire, principally at Burslem, beginning in the latter half of the 17th century. The presence of both clays and coal in this district gave impetus to the industry here.

Josiah Wedgwood, born in 1730 at Burslem, was the greatest of English potters and among the foremost potters of the world. He came of a family of potters who became notable in the 17th century. In 1759 he started his own pottery at Burslem. After perfecting a creamcolored ware with a beautiful soft glaze of creamy texture, he presented the first specimen, a breakfast set, to Queen Charlotte in 1762. The Queen ordered a dinner set. At once the ware became fashionable and, by permission, was named "Queensware." He learned how to make a fine unglazed stoneware and gave such names as "jasperware," "caneware," and "black basalt" to its many varieties. The vases and other forms decorated in white relief on blue, or green, or lilaccolored jasper body came to be regarded as the characteristic "Wedgwood ware." Among popular shapes were medallions of celebrated men of the day and small reliefs for use in jewelry. The black basalts were largely used for portrait busts and mantel ornaments.

His shapes and decorations were strongly influenced by classical forms. From 1775 on, John Flaxman, the famous sculptor, designed the cameo reliefs for these types of Wedgwood pottery. The supreme achievement in jasperware was a copy of the Portland vase, an extraordinarily beautiful urn, found near Rome about 1640, owned by the Portland family, and long

TRIUMPHS OF THE POTTER'S ART IN THE ORIENT

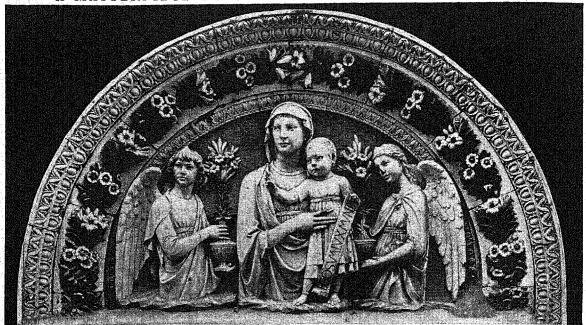


1. Glazed and lustered bowl from Rhages, Persia, 12th century.
2. Chinese plate, with flying duck, clouds, and lotus design, in brown, green, and blue glazes; Tang dynasty, 618-906 A.D.
3. Persian jar, 13th century, of the Rhages type, glazed in turquoise, with fish and seaweed design in black. 4. Model of a watch tower, in green glazed pottery, placed in a tomb; Han dynasty, 206 B.C. to 220 A.D. 5. Japanese censer, early 19th century, base of Satsuma pottery in crackled cream glaze, design of

tortoise and jewels in green and red enamels. 6. An 18th-century tea caddy of "Chinese Lowestoft," ordered in China by employees of the East India Co. 7. One of the Lions of Buddha, from the K'ang Hsi period. 8. Chinese wine jar, about 1500 A.D. The reader should note that the objects in this page of illustrations are not represented in their relative size. The Persian bowl, 1, is in the Metropolitan Museum of Art, New York City, and 2, 3, 4, 5, and 6 are from collections in the Art Institute of Chicago.



A MASTERPIECE BY A SCULPTOR WHO TURNED POTTER



For centuries this madenna and the angels smiled down from the doorway of the Casa Tantini in Florence, Italy. It is a priceless work by Luca della Robbia, the famous Renaissance sculptor who learned how to make the exquisite "Della Robbia ware." His nephew, Andrea della Robbia, carried on his work with somewhat less skill. This madenna is now in the National Museum, Florence.

kept in the British Museum. So fine was Wedgwood's cameo work that he had a large trade in furnishing it to the jewelers of the day. Other potters of this period were Josiah Spode, the outstanding porcelain manufacturer of his time, and Ralph Wood, who was famous for whimsical pieces such as Toby jugs, puzzle jugs, toad mugs, and vessels decorated with comic inscriptions.

Among the many lovely English tablewares of the 18th century none has been more sought than "Lowestoft." The Lowestoft factory was not long lived and its output was relatively small. Its porcelain and decorations had in many cases a distinctly oriental look, but this was not peculiar to Lowestoft. It is more than probable that the larger part of the socalled Lowestoft, which was often decorated with crests and monograms of English families, was made to order in China from sketches. This may be as beautiful as the "real" Lowestoft; indeed, it is sometimes more so, but it is made of a hard paste, whereas the English is soft. The difference may be easily ascertained by scratching the unglazed under-edge.

"Belleek" ware has been a famous product of Ireland since 1857. Its thin, highly translucent hard porcelain and ivory luster have been widely admired.

"Rockingham" ware is the name given to the pottery, mostly teapots, made of cheap brown or yellow clays and glazed brown with manganese. It is made in both the United States and England.

Little true porcelain has been made in the United States. Most so-called porcelain is a very fine though porous earthenware with a soft bright glaze. Other

types of dinnerware extensively made in the United States are those called "American hotel china," which is thick and heavy with a hard glaze, and "American Belleek china," a tough translucent ware, usually highly decorated.

The chief centers for the extensive pottery interests of the United States are in Ohio and New Jersey. In addition to a large output of general ware for home and hotel and restaurant use, much beautiful craft pottery is made, such as "Lenox," "Hager," "Dedham," and "Rookwood." Mrs. Bellamy Storer started the Rookwood pottery in Cincinnati in 1880. aiming to produce a distinctly American ware.

Tiles, porcelain and stoneware for electrical and chemical purposes, and sanitary earthenware are also important products of the pottery industry. (See also Brick and Tile.)

For anyone having the "collector's instinct" the first consideration is quality, and the second the "mark," initials, full name, or private insignia. Many authentic "marked" pieces are inferior to others, and sometimes inferior to unmarked pieces. "How can I recognize quality?" is often asked. There is but one sure way, namely, by seeing examples of the best. This can be done at any of the large museums. In fact, there is no better way of introducing oneself to the beauties of the art of the potter than by visiting collections of good standing. Learn, as you can easily, the look of the ware and the character of its decoration in one or two examples at each visit. It will amaze you how soon you will acquire knowledge of what is excellent in pottery.

FAMOUS STYLES IN THE POTTERY OF MANY LANDS



1. An 18th-century Chelsea porcelain figure of a hunter. 2. A vase in Mexican maiolica, 1680, in a fine rhythmic pattern of blue and white. 3. The Empress Elizabeth of Russia, daughter of Peter the Great, in 18th-century Meissen ware. 4. A plate of 16th-century Italian maiolica in Florentine design. 5. A vase in the famous jasperware of Josiah Wedgwood, great English potter, who followed the 18th-century taste for classical models.

6. "Tulip ware", made by the Pennsylvania Germans in the early 19th century, often had a design of tulips, much conventionalized.
7. Bernard Palissy, French master of ceramics, loved to model on his platters water creatures dredged up from the Seine. 8. Chinese influence is apparent in this 18th-century delft plaque. The Tulip ware plate is in the Metropolitan Museum of Art, New York City, and 1, 3, 5, and 8 are in the Art Institute of Chicago.

The HEN and Her GOLDEN EGGS

The Vast Wealth Produced by the Clucking Citizens of the Poultry Yard and Their Cousins, the Ducks, Geese, and Turkeys—Modern Methods of Chicken Raising and Some Egg-Laying Records

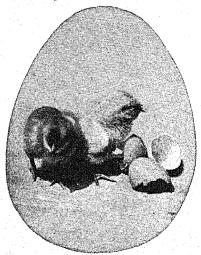
POULTRY. Every American hen more than pays for the cost of two Panama Canals. The value of poultry products in the United States normally exceeds that of the wheat crop, and all but a small proportion of this comes from the common domestic fowl, or chicken. More than half of this surprising sum is the value of the eggs produced. The hen's egg is the only one of commercial importance, for practically all the eggs of other domestic fowls are used for hatching. Chickens also are far in the lead as meat producers. Of every 1,000 of the fowls available for marketing, about 940 are chickens, 40 are turkeys, and 17 are ducks. The others are geese and guinea fowl.

The importance of poultry as a factor in national wealth is not appreciated by most people, chiefly perhaps because chickens and eggs are generally byproducts of the farm. Except on a few large poultry farms, they are generally raised by the farmer's wife, who may or may not be able to give them the same degree of attention that the farmer gives to the main crops. In the United States, however, coöperatives have begun to organize the marketing of poultry and

eggs, as has been done in Denmark. Danish producers normally do their selling through a cooperative association that stamps every egg with an identification mark and holds each producer responsible for the quality of his eggs. The United States Department of Agriculture estimates that \$50,000,000 a year is lost through bad methods of

handling eggs, all the way from the farm to the market.

More than 660,000,000 chickens a year are raised on the farms of the United States, besides millions in "back-yard" flocks, not reported in the census returns. Chickens rank third, next to hogs and cattle.



Just out of the shell and looking around at the strange new world.

as a source of food, for in an average year about 350,000,000 pounds of dressed chickens are received at the chief markets. and the latest decennial census shows about 340,000,000 chickens are kept on farms to produce eggs. In one year they laid 28½ billion eggs-about 218 for each person in the United States. Millions of pounds of dressed poultry and eggs are placed in cold storage to insure a constant supply, especially during the winter months. Under the modern system of separating the roosters from the hens at the close of the breeding season, which is now practiced by most poultrymen, infertile eggs are produced which will keep a longer time. Eggs can be preserved in the home

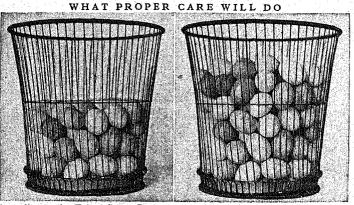
by keeping them in water glass. Commercially, great quantities are preserved for months in cold storage. For baking and other commercial uses they may be frozen, or dried and powdered.

Cock Crows at the Dawn of History

When chickens were first tamed and raised by man is not known. Scientists believe that the wild fowls from which our tame breeds originated were natives of southwestern Asia, and that one of the species

which contributed most largely to its ancestry is represented today by the red jungle fowl of India. This wild fowl is smaller than a prairie chicken, while a specimen of one of our meat varieties ready for the market sometimes weighs as much as 16 or 17 This is pounds. one of the many striking examples of what breeding

ket at the left contains 80 eggs. With striking examples ge 150 eggs a year; the basket at the of what breeding and care will accomplish. Similarly in the production of eggs, while the wild fowl lays only one small setting of eggs a year, a flock of good layers today will average 150 eggs a year. Individual hens have reached a mark well over 350, and the 200-egg-a-year hen is now com-



According to the United States Department of Agriculture, the average production of eggs per hen is 80 a year; the basket at the left contains 80 eggs. With proper feed and care, a hen should average 150 eggs a year; the basket at the right gives you a picture of what this added production would mean.

IMPORTANT BREEDS OF POULTRY



Plymouth Rock



Wyandotte



Orpington



Rhode Island Red

mon. Improvement in weight of meat and number of eggs produced in any flock may be brought about by selecting only the best for breeding purposes, by keeping in a clean well-aired poultry house, and giving plenty of clean water and good feed, selected in proper variety for a balanced ration. The trap nest system, which enables the poultryman to keep an accurate egg-laying record of each hen, is a great aid in improving a flock for egg production. There are other methods too by which the poor layers can be eliminated and the eggs for setting selected from only the layers with the highest records.

The hen seldom exercises the art of the wild fowl in making her own nest for her eggs, but occasionally one desiring to sit will steal away to a nest hidden in a spot of her own choosing, and lay her one egg a day until there are as many in the nest as her feathers will cover. She will then patiently keep them warm with the heat of her body for 20 to 21 days and bring off her little brood of downy chicks.

How the Little Chicks Go to School

A mother hen exhibits a highly developed instinct in caring for her family. She teaches them by patient example how to drink, how and what to eat, and calls them with special fervor to enjoy a worm or tempting bug. If



Cochin



Langshau



Brahma

danger threatens, her prompt warning makes them hide under the nearest cover. When their old enemy the hawk sails menacingly overhead, his fleeting shadow on the ground is spied by some watchful chicken, and a warning sounds that sends even the grown-up members of the flock hurrying to cover. This instinctive fear was developed ages ago by the dangers of wild life, where hawk, fox, weasel, and other animals showed a marked fondness for fresh chicken; and after centuries in the domestic fold this instinct still is active.

The time of sitting and of caring for a brood is just so much time lost from laying, since the hen does not begin laving again until the young chickens are well able to care for themselves. For this reason, in a flock of any size, sitting is discouraged by the poultryman. The hens that show a desire to sit by staying on the nest, and clucking while off the nest, are cooped up to "break" them from sitting. In place of the sitting hens, with their tiny broods, we have the incubators in which eggs by the thousands are placed for hatching. Artificial incubation is not a new practice, for the ancient Egyptians placed eggs in large brick ovens which held an even heat, hatching them in large numbers. The incubator is planned to imitate the natural conditions for hatch-



Andalusian



Ancona



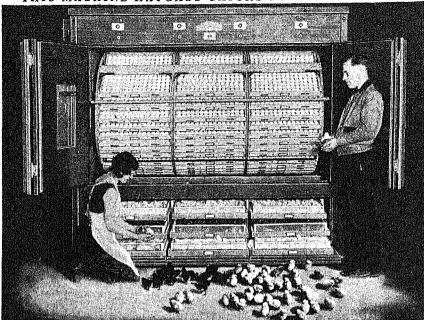
Minorca



Leghorn

The upper row includes the breeds best for general purposes; they are good layers and attain medium size. The lower row includes the best layers, while the middle three are heavy meat breeds.

THIS MACHINE HATCHES CHICKS BY THE THOUSAND



This electrically-heated incubator holds 10,000 eggs. They are placed in trays in the drum which can be turned through a 90-degree angle. Formerly every egg had to be turned by hand twice daily. Below are compartments where the eggs are put when ready to hatch. Revolving blades circulate the air to keep every egg at a uniform temperature.

ing. A warm even temperature is provided by means of lamps automatically regulated, with a supply of fresh and slightly moist air. Since the mother carefully turns the eggs in her nest, so likewise the eggs in the incubator are turned over frequently during the period from the third to the eighth day. At the end of one week the eggs are tested and the infertile eggs, those which are not going to hatch, are removed. The test is made by the process known as "candling." The eggs are held before a light, and the infertile eggs appear clear and translucent. At the end of 14 days a second test is made to weed out those in which the germ has died. Finally at the end of the third week comes the time of greatest interest, when first one

and then many of the tiny bills hammer on prison walls and the downy yellow chicks make their way out of their imprisoning shells. From the incubator they are put in a warm brooder, where they live the life of pampered little orphans who are not allowed to venture out in the wet grass to hunt their food, but are fed and cared for scientifically until able to care for themselves.

Poultry farms with extensive runs and scratching pens for winter feeding are operated on a larger scale in the United States than in any other country, but poultry raising in some form is practically a universal industry. One feature of poultry raising in European countries which seems odd to us is the common

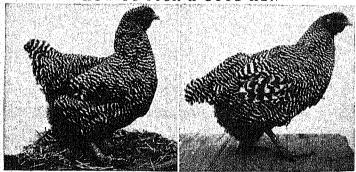
practise of pasturing their flocks. One person is often hired to take all the turkeys in a village out to forage for themselves, and the goosegirl, or goose-herd, tends the geese while they feed. They also drive them along the road to market. In Italy, for example, it is a common sight to see large flocks of geese driven down from the Alps to the nearest market.

There are about 100 standard varieties of domestic chickens, falling into three main classes—Asiatic, Mediterranean, and American. The Asiatic breeds, which originated in China, are large and heavy, being valued as meat producers rather than as layers. The Mediterranean breeds, which come mostly from Italy and Spain, are smaller and noted chiefly

for their laying qualities. The American breeds, all of which have been developed in little more than half a century, combine the qualities of both meat and egg production.

The best-known breeds in the three classes are: (1) Asiatic: Brahmas, Cochins, Langshans; (2) Mediterranean: Leghorns, Minorcas, Spanish, Blue Andalusians, Anconas; (3) American: Plymouth Rocks, Wyandottes, Rhode Island Reds. England has also produced some distinctive breeds, especially famous for the excellent quality of their meat, including the well-known Orpingtons. Several varieties known as "games," including the Black-breasted Red Game—one of the oldest varieties of domestic

HOW TO PICK A GOOD HEN



The Hen at the left has the correct points. Its general carriage is erect. The neck is plump and square, the back flat and broad, the breast well filled, and the legs are of medium length. The bird at the right, on the contrary, will be a poor layer and will never be strong. The carriage is bad, due to the length of leg and the shallowness of the breast. The back, too, instead of being level, slopes downward, very much like stooped shoulders in some human beings.

fowl known—were developed originally for cockfighting, but they now compare favorably in egg production with other classes, besides being excellent for meat.

Besides these breeds there are the ornamental varieties and others raised chiefly as curiosities, such as the white-crested black Polish fowl, with its odd white cap of feathers. The bantam breeds are interesting members of the poultry family, although there is no practical advantage in their dwarfed size and small eggs. Scientific name of domestic fowl, Gallus domesticus. (See also Duck; Goose; Turkey.)

POWER. Thousands of men worked for generations to build the great pyramids of Egypt. Today, with the help of modern machinery, a few hundred men could complete them in a few months. The difference in time consumed lies in the application of power.

Just what is power? The words work, energy, and power are used loosely in common speech, but to the engineer each has a distinct meaning. Work means the overcoming of resistance; energy is the capacity for doing work; but power implies the capacity for doing work at a given rate of speed. In building a pyramid, for example, the amount of work done and the energy used in doing it would be much the same whether the task was performed by human hands over many decades or by stone-cutting machines and steam hoists in a single season. But the power applied in the latter case would be many times greater than in the former (see Energy; Physics) because work is done faster.

We often boast that our material civilization has advanced more rapidly in the last 200 years than it did in the preceding 2,000. For this progress we must thank the seven-league boots of power, which we have learned to extract chiefly from coal and water, and to use in driving machines.

Man's first source of power was, of course, his own muscles. But hundreds of centuries ago he learned how to supplement his efforts with those of domesticated animals. Most useful of all, because of its strength, speed, and ease of handling, was the horse. For ages the amount of work a man could do depended in large part on the power of the horses available to him. And ever since then power has been measured in terms of the work a horse could do. One horse-power is the power required to raise 33,000 pounds one foot in one minute. It is about ten times the power which the average man can exert consistently throughout a day's work.

Perhaps the first application of power from nonliving forces of nature came when men hoisted sails over their boats to harness the wind. Thousands of years elapsed before the same principle, slightly modified, was applied to driving windmills. The Egyptians and Greeks used the energy of flowing streams to drive crude water wheels, but again the extensive development of this form of power lagged until the end of the 18th century.

Newton, with his famous laws of mechanics, and the long line of great scientists who followed him, were

the prophets who pointed the way to our modern power era. They showed what principles had to be followed to put energy to work through machines. Inventors followed in the footsteps of the scientists. The steam engine transformed our civilization simply because its boiler was able to turn coal into steam. and the engine turned the expansion of the steam into power. The hydraulic turbine harnessed the force of falling water. Both steam and water were set to driving electric generators which distributed power over fine wires to countless humming motors. The energy locked up in petroleum was turned into power by the gas engine, and within a single generation millions of automobiles were rolling over our roads and streets. Because this particular kind of engine developed more power for its weight than any previously invented, it made flying possible. (See Electric Light and Power; Fuels; Gas Engine; Steam Engine: Water Power.)

If the total mechanical power in use in the United States today were converted into man power, it would provide at least 100 hard-working slaves for each man, woman, and child in the country. And here is another side of the story. Even if it were possible to do all the country's work with man power, and all the necessary men could be hired at \$5.00 a day, it would cost about 800 times as much as it would by doing it with fuel, water, and machinery.

You will often hear engineers talk about the "efficiency" of a machine. In this technical sense, the word generally means the amount of useful power a machine develops in proportion to the energy that is fed into it. If a locomotive, for example, could use all the energy released by the coal it burns in driving itself along the rails, its efficiency would be 100 per cent. But of course, much of the heat escapes into the air and much energy is lost through friction, with the result that a locomotive's general efficiency is rarely as high as 15 per cent. Hydraulic turbines, having virtually no heat losses to contend with, sometimes reach a general efficiency of 90 per cent.

New Sources of Power

The search for new sources of power goes hand in hand with the effort to design more efficient machines. It is no fantastic dream, for example, to draw useful energy from volcanoes. In Italy and in California this has already been done with some success. Some day we may see street lamps lighted by the moonnot by its feeble rays, of course, but by its tideproducing energy. England has already estimated the power possibilities of the tides along her coasts, as being equal to that of 40 million tons of coal annually. Attempts to collect and concentrate the heat rays of the sun as a direct source of power have been numerous. So far the apparatus required has been too expensive to compete with coal. A novel method for tapping a new source of power has been made by Georges Claude, a French inventor. Into the depths of tropical seas, he sank a mile-long steel tube through which very cold water is pumped up. Using this in

KLOTAMATOW!

conjunction with the warm surface water, differences in vapor pressure are set up sufficient to drive specially designed motors.

For the various units used in measuring energy, work, and power consult the tables in the article on Physics. The common measure of electrical power is the watt. One horse-power equals 746 watts. The kilowatt is one thousand watts

and equals 1.34 horse-power.

POWERS AND ROOTS. The subject of Powers and
Roots seldom appears in the school arithmetic of

Roots seldom appears in the school arithmetic of today, because it is of little practical importance in business. It is, however, sometimes made use of as a supplemental topic in the eighth grade, especially as "star" work for selected pupils. Many people, also, desire to have the formulas used at hand. For these reasons, a simple development is here given.

When we double, treble, or quadruple a number we raise it to its 2d, 3d, or 4th power. Thus, $4(2\times2)$, $8(2\times2\times2)$, $16(2\times2\times2\times2)$ are the 2d, 3d, and 4th powers of 2. The number itself is its first power. Powers are indicated by exponents, thus, 2^2 , 2^3 , 2^4 , 2^5 . In algebra powers are shown in the same way: m^2 , m^3 , $(a+b)^2$ $(x-y)^3$. The 2d power is the "square," the 3d power is the "cube." Any number with exponent 0 equals 1; a negative exponent means the number is to be used as a denominator, thus: $3^{-2} = \frac{1}{32}$.

If the number we wish to square (raise to the 2d power) consists of two digits or terms, as 25, 34, 86, a+b, b-c, the process of multiplying the number by itself reveals a certain law which helps with the reverse process of working back from the square to the first power (finding the square root). Compare the steps in the same multiplication done two ways:

We see, then, that the square of 25 (625) is made up of the square of the first term $(20\times20=400)+$ twice the product of the first term by the second $(2\times20\times5=200)+$ the square of the second term $(5\times5=25)$. Compare with the following algebraic operations:

$$(a+b)^2 = a^2 + 2ab + b^2, \text{ or } a^2 + ab$$

$$ab + b^2$$

$$a^2 + 2ab + b^2$$

$$a^2 + 2ab + b^2$$

$$(b-c)^2 = b^2 - bc$$

$$- bc + c^2$$

$$b^2 - 2bc + c^2$$

Now, if we understand that law, the operation of finding the square root will be simple. By looking at these squares: 49, 64, 81, 144, we perceive that their square roots are, respectively, 7, 8, 9, 12. But we can seldom tell what the square root is by *inspection*. We must work it out by steps, as the examples on the next page show.

These steps employ the same process used in solving the similar algebraic problem. Thus, in the first problem solved we find the square root of 784 to be 28. We can say $784 = (a+b)^2$, and make a=20, and b=8. Then $a^2+2ab+b^2=400+320+64$, or 784. The position of the 2 in the root makes it equal to 20, and by subtracting 4 in the position shown, we really subtract $400(=a^2)$. Our complete remainder then amounts, in algebraic terms, to $2ab+b^2$. Dividing 2a (that is, $2\times2\times10$) into it gives us b(=8) as a trial quotient, and multiplying 40+8 by 8 gives us the arithmetic

equivalent of $2ab+b^2$. If the given number (as in example II) contains five or six digits, we are dealing with a root having three digits, and our corresponding algebraic expansion is of the form $(a+b+c)^2=a^2+2ab+b^2+2ac+2bc+c^2$. Our first step gives a trial quotient equal to a, and subtracts a^2 . Our second step gives a trial quotient equal to b, and subtracts $2ab+b^2$. Our third step gives a trial quotient equal to c, and subtracts $2ac+2bc+c^2$.

Cube Root

Similarly, we may find a law about the make-up of a cube which will help us to understand the process of finding the cube root. Let us cube 12:

12	Writing this as	10+ 2
12	10+2 and squaring	10+ 2
$\overline{24}$		$\overline{100+20}$
12		20+ 4
144		$\overline{100+40+4}$
12	multiplying again	10+ 2
288	to get the cube	1000+400+40
144		200+ 80+8
1728		1000+600+120+8=1728

In algebraic form our number amounts to $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$, in which a = 10 and b = 2. Our solution follows the algebraic one, as the following example, using a different number, will show:

Find the Cube Root of 15,625

- 1. Point off the given number into periods of three numbers each:
- Determine the largest number whose cube goes into the first period, write it as first figure of the root, and subtract its cube. This subtracts a³ from our number. Subtracting in the 1,000 column allows for the root number being a multiple of 10.
- 3. Multiply the root number by 10, square the result, and multiply by 3 (this gives $3a^2$). Use as a trial divisor, obtaining trial quo-

3ab). Add this to the trial divisor and add the square of the second term, obtaining the complete divisor $(=3a^2+3ab+b^2)$. Multiply by the trial quotient, obtaining 7625 $(=3a^2b+3ab^2+b^3)$. This subtracted from the dividend, leaves no remainder, so the desired root is 25.

Calculating with Logarithms

Many calculations can be simplified by using a form of powers called *logarithms*, in which every number is considered a power of 10. They are valuable because with them addition and subtraction can be substituted for multiplication and division, while multiplication gives powers and division gives roots.

For a simple example, 100 is the second power of 10 $(100=10^2)$, while 1,000 is the third power $(1,000=10^3)$. To multiply 100 by 1,000, we could add the logarithms (2+3=5). 5 is the "logarithm" of 100,000, the desired answer. To divide 100,000 by 1,000, subtract the logarithms. (5-3=2). 2 is the logarithm of 100 (that is $100=10^2$). 100 is the answer.

Most numbers, however, are not even powers of 10. Thus the logarithm of 1,074 is slightly greater than 3, since 1,074 is slightly greater than 1,000. Calculation shows it to be 3.031. That is, 10^{3.031}=1,074. The proper numbers for all logarithms desired are calculated and their values are printed in tables, for reference. In the tables, only the fractional part (called the *mantissa*) is printed, the user supplying the whole part (called the *characteristic*) for himself. Thus, in a "4-place" table of logarithms (one giving four figures on

SUCCESSIVE STEPS IN EXTRACTING SQUARE ROOTS

I. Find the Square Root of 784

- 7'84
 Point off periods of two numbers each, counting from the decimal point.
- 7'84(2
 Find the largest number (here = 2) whose square (here=4) is contained in the left-hand period.
 Write, as shown, as the first figure of the root.
- 3. 7'84(2 3. Write the square of this number under the lefthand period, subtract, and to the remainder add the next period, to form a new dividend.
- 4. Not written in actual problems—see explanation.

 $2 \times 2 = 4$. $4 \times 10 = 40$. $384 \div 40 = 9 + \text{Rem}$.

- 5. $2\times2=4$. 7'84(28) $4\times10=40$ $\frac{4}{3}$ 84 $18\times8=\frac{3}{0}$ 84
- hand period, subtract, and to the remainder add the next period, to form a new dividend.

 4. Double the figure in the root, multiply by 10, and divide the product (=40, and called a trial divisor)
- divide the product (=40, and called a trial divisor) into the remainder. Do not write out this step—it is written out here merely for illustration. Here, the trial divisor 40 goes into 384 nine times with a remainder. We may call 9 a trial quotient.

 5. Add the trial quotient to the trial divisor, obtaining
 - Add the trial quotient to the trial divisor, obtaining a complete divisor. Multiply by the trial quotient, and subtract from the new dividend. Here we meet the point which most often troubles people when extracting square roots. Our procedure has given us $49\times9=441$, which is greater than 384. Obviously 9 is too large a trial divisor; so we try 8. The new product of $(40+8)\times8$ is 384. Write 8 as the second figure of the root; complete the operation as shown. Since there is no remainder, the root is 28.

Solving More Complicated Problems

III. FIND THE SQUARE ROOT IV. FIND THE SQUARE ROOT II. FIND THE SQUARE ROOT of 600.25. or 15.625. OF 942.49 $2 \times 2 = 4$. 6'00.25'(24.5 9'42.49'(30.7 $2 \times 1 = 2$. 1'56'25(125 $4 \times 10 = 40$ $2 \times 10 = 20$. 200 +456 42 00 $44 \times 4 = 176$ $22 \times 2 = 44$ 24 25 4249 $2 \times 12 = 24$. $24 \times 10 = 240$ 12 25 $2 \times 24 = 48.$ $48 \times 10 = 480$ +5607×7 ±42 49

 $485 \times 5 = 2425$

00 00

The first figure of the root is 1. Steps 4 and 5 give trial divisor 20, trial quotient 2, and complete divisor 22. The second digit of the root is 2; the new dividend is 1225. The next trial divisor is 240, the trial quotient is 5, and there is no remainder.

The desired root is 125.

 $245 \times 5 = 1225$

Point off periods of two numbers, counting each way from the decimal. Proceed as before, putting a decimal point in the root after the trial quotient obtained by using the period just to the left of the decimal point (the period in this case is 00 and the trial quotient is 4). OO OO

Here the first new dividend is 42, and the trial divisor is 60—larger than 42, and no trial quotient can be obtained. Write 0 in the root, bring down the next period (49), and use 600 as the trial divisor. This gives a trial quotient 7, which works out as shown. The decimal is placed according to the rule in example III.

This table works out one problem in full detail, with calculations and explanations. The additional illustrations give solutions involving points that often trouble students.

each mantissa), the only figures given for 1,074 are 0311. The reader knows that since 1,074 is slightly greater than 1,000, his characteristic must be 3, and the complete logarithm is 3.0311. If he wants the logarithm for 10.74, he knows that since 10.74 is between 10 and 100, the characteristic must be 1, so the complete logarithm is 1.0311. Decimal fractions have negative characteristics.

To multiply 1,074 by 10.74, we add their logarithms, obtaining 4.0622. The nearest number in the table corresponding to mantissa .0622 is 11,535. The characteristic 4, means that our number must be between 10,000 and 100,000, so it must be 11,535. (The product actually is 11,534.76, the discrepancy being due to the fact that no table of logarithms gives mantissas long enough to yield absolutely accurate answers.) We divide by subtracting logarithms.

To cube 1074, we would multiply its logarithm by 3, obtaining 9.093. The table shows that mantissa .093 corresponds to the number 1239, which because of the characteristic 9, must be written 1,239,-000,000. Actual computation of the number shows it to be extremely close, considering its size-1,238,-833,224. To obtain a more accurate result, we would only need to use a table giving more figures for each Just as powers are mantissa obtained by multiplying logarithms, we obtain roots by dividing logarithms. Logarithms were invented by the

Scottish mathematician Napier, and used by him in a form similar to the modern slide rule (see Slide Rule). ${f PRAGUE}$ (präg or präg). From the towering heights of the Vyšehrad ("White-hill"), one looks down upon a city that has existed since early medieval times. It is a picturesque city, with spires by the hundreds, green domes, and red manygabled roofs. This is Prague, or in the Czech language Praha, once capital of Czechoslovakia and now capital of the German protectorate of Bohemia and Moravia. It lies near the western border of the fertile Bohemian basin.

Through it the Moldau or Vultava (a tributary of the Elbe) wanders, cutting Prague in two—broad and swift, hurrying under beautiful bridges. Long timber rafts, on which men run to and fro with tall poles, float slowly by. Boats cross from side to side.

The people like to spend the summer out of doors—walking, sitting under the trees on islands in the river and in the gardens of many cafés and in the parks. They bring their books and their work with

them; they bring little packets of sweets, and there is generally music in some corner near, the wild sweet music of Dvorák and Smetana.

The older parts of the town give one a strange sensation of being still in the Middle Ages, when one comes upon the great archways leading into narrow alleys or opening into dim courtyards. Twisting lanes lead from street to street. Restaurants show a glimmering light at the end of a long darkened passage.

In the midst of government buildings on the west bank of the river stands the cathedral of St. Vitus, restored twice since its founding in 930. From the Old Town Square on the east bank rises the Tyn Church, more than 500 years old. The main business district hugs the Old Town Square. Scattered through the city are the many buildings of the University of Prague, founded in 1348 and split in 1882 into two divisions—Bohemian and German. The Bohemian national hero and martyr, John Huss, was one of its most famous lecturers (see Huss, John).

Streetcar and bus lines lead east and west from the "Old Town" to modern Prague, which resembles the most up-to-date American cities. The monotony of apartment houses and wide regular streets is relieved

by extensive parks with natural terraces.

Prague's importance as a center of finance, commerce, and manufacturing has greatly diminished since 1939, when Czechoslovakia disappeared from the map and most of it became a German protectorate (see Czechoslovakia). Prague seems certain, however, to retain a measure of its commerce, because it stands at the intersection of Europe's important air and rail lines, and has a navigable river. Its industrial plants include sugar refineries, breweries, chemical factories, and railroad car and locomotive shops.

Prague's history has been largely the stormy history of Bohemia, of which the city has been the capital since ancient times. Population, about 850,000.

PRAIRIE-DOG. A group of little hillocks spread over the landscape; a plump little animal or two seated upon each hillock curiously scrutinizing the approaching stranger—that is the visitor's first pic-



ture of a prairie-dog "town." As he draws nearer, the animals pop into the hillocks with lightning speed; then when he has passed they cautiously emerge again to watch him.

The hillocks, spread so picturesquely over the plain, are entrances to burrows, which extend sharply down into the ground sometimes a dozen feet or more. They form a secure shelter to keep out the water in a

heavy rainfall. From the bottom of the steep shaft extends a winding horizontal tunnel, which sometimes ends in a room for the storage of fodder or the accommodation of the young prairie-dogs. In the summer the prairie-dogs eat grass, alfalfa, and other plants and store food for the winter, when they retire to the comfortable depths of their homes to sleep the months away.

These colonies are very common on the western plains in Montana, Wyoming, western Kansas, Texas, New Mexico, and Arizona and on the slopes of the Rockies in Utah and Colorado. The burrows are often frequented by weasels, badgers, and snakes which prey on their hosts and keep down their numbers. With the general settlement of the country came the destruction of these enemies, and as the cultivation and irrigation of hitherto arid country gave the prairie-dog a plentiful supply of food they increased prodigiously until at the beginning of the

present century they were a great nuisance to the farmer and ranchman. In western Texas one continuous colony is about 250 miles long and 100 miles wide. It is estimated that in the entire state of Texas 90,000 square miles are occupied by prairie-dogs and the number of these animals within this area runs into hundreds of millions. One square mile in eastern Arizona by actual count contains 7,200 burrows.

The prairie-dog is in no sense a dog, but belongs to the order of gnawing animals. Its bark, from which it gains its name, is short and sharp, like a puppy's.

Like its near relative the groundhog or woodchuck, the prairie-dog is a true marmot. The marmots and the ground-squirrels make up the large subfamily of the squirrel family called the Arctomyinae. All the members of this subfamily are distinguished from the true squirrels by having proportionately shorter and stouter bodies and shorter tails. There are many varieties of marmots, differing widely in size and color. In Europe they range through the Alps through Asia north of and including the inner ranges of the Himalayas. The best known European variety is the Alpine marmot (Arctomys marmotta).

Scientific name of prairie-dog, Cynomys ludovicianus; length from 14 to 17 inches; weight from 2 to more than 3 pounds; hair pale chestnut, lighter beneath. Found only in the interior of North America.

PREPOSITION. The meaning of nouns and verbs is rendered clearer and more precise by the use not only of adjectives and adverbs but also of certain groups of words performing the same service. When we say "a girl with yellow hair" it is evident that the group of words "with yellow hair" is equivalent to the adjective "yellow-haired." In the sentence "The foe fled with haste," the group of words "with haste" clearly modifies the meaning of the verb "fled" and is equivalent to the adverb "hastily." We call such groups of words prepositional phrases. If they modify nouns and pronouns, as adjectives do, they are called adjective phrases; if they modify verbs, as adverbs do, they are called adverbial phrases.

If you examine a number of such phrases you will find that they all consist of two principal elements; a substantive and an introductory word, usually a short one, like in, for, by, with, against, etc. This introductory word is called a preposition, from the Latin praepositum meaning "placed before," because it is usually placed before the substantive it introduces; or, as we say, governs. The duty of the preposition is to show the relation between the word it governs and the word the phrase modifies. Thus, in the sentence, "It will rain before tomorrow," the preposition before shows a relation of time between the verb will rain and the noun tomorrow.

Though there are comparatively few prepositions, they express a great variety of relationship, such as time, place, manner, means, agency, cause, accompaniment, opposition, source, destination, etc. The same preposition may express several of these rela-



tions in different uses; as with a hammer (means), with speed (manner), with me (accompaniment).

Misuse of these important little words is a common error in speaking and writing. You will often hear careless speakers say, "I went in the house," for into the house"; "I got the book off of him," for "from him"; "He is staying over to my house," for "at my house"; "She wasn't to home," for "at home."

PRESIDENT OF THE UNITED STATES. It has often been said that the president of the United States exercises more power than any other elected ruler of modern times. And it is indeed true that few other republics have given their chief executive a power comparable to his.

How did it happen that the framers of the Constitution, who had felt so heavily the weight of the royal power of Great Britain and of their colonial governors, felt it wise to put so much authority in the hands of one man?

One reason, and perhaps the chief reason, was that for six years the states had been striving to exist under the Articles of Confederation. In that time they had bitterly learned the weakness of a leaderless government (see Articles of Confederation). One of the first questions, therefore, to be taken up at the Constitutional Convention in 1787 was the establishment of the executive power. (See United States Constitution.)

Among the proposals offered to the convention was that the executive power be vested in three persons—one from the North, one from the South, and one to represent the Middle States. The Articles of Confederation, however, had already given the delegates experience with one form of "plural" government; so they quickly rejected the plan.

Pinckney Proposal Adopted

Charles Pinckney suggested that "the executive power be vested in a 'President of the United States of America'." This proposal to confer the executive authority upon one person found general favor and was adopted, for the delegates were familiar with this type of executive system, though on a smaller scale. Each of the state constitutions had already vested executive authority in one official, who was called "governor" in some states and "president" in others, though none had powers of such scope as those entrusted to the federal executive.

Difficulty arose when the convention tried to determine the length of time that a president should serve. Alexander Hamilton, ever a proponent of a strong federal government, suggested that the president should serve for life. This plan was rejected in favor of one to limit the term to seven years, and just before the convention adjourned the term was changed to four years.

Even while the convention was still debating on the presidency, there was little doubt as to whom the nation wanted for president. George Washington was unanimously elected, and was inaugurated April 30, 1789, as the first president of the United States. Some writers have mistakenly held that John Hanson of Maryland was the first president of the United States. This confusion is caused by the fact that Hanson, in the days of the Articles of Confederation, was for a time the presiding officer of the Continental Congress, which then called itself "The United States in Congress Assembled." This body called its presiding officer "president." The office of president of the United States, however, was not established until the Constitution created it.

Qualifications of the President

The Constitution provides that no person except a native-born citizen, over 35 years old, and for 14 years a resident of the United States, may be elected president. It does not limit the number of times the president may be re-elected; but, by refusing a third consecutive nomination, Washington set a precedent which was not broken until, in 1940, the Democratic party nominated President F. D. Roosevelt for a third term.

The Constitution further provides that the president shall be elected, not by the legislature, nor by the people, but by a special group of presidential electors. "Each state shall appoint, in such manner as the legislature thereof may direct, a number of electors, equal to the whole number of senators and representatives to which the state may be entitled in Congress." The makers of the Constitution thus clearly intended that this Electoral College should be independent of the people in choosing a president.

For a few years the spirit of the Constitution was followed, as the electors actually chose the president; but the rise of party politics soon made the electoral vote only an echo of the popular vote. The electors still nominally have the right to choose whomever they deem best qualified, but precedent and popular opinion bind them to vote for the candidate sponsored by the party which elects them.

In the spring or early summer of a presidential election year, each of the political parties holds a national convention to choose its candidate for the presidency. On the Tuesday after the first Monday in November of that year, each party submits to the voters a list of electors, who will vote in the Electoral College for their own party candidate. That is why we usually know, as soon as the electors have been chosen, who the new president will be, even though he is not formally elected until Congress counts the ballots of the Electoral College in January.

Should no presidential candidate receive a majority in the Electoral College, the House of Representatives chooses the president by ballot from the three who have the highest number of votes. In this balloting each state has one vote. The vice-president would be similarly chosen by the Senate.

From time to time there has been agitation to abolish the Electoral College on the ground that it does not represent the full will of the people. Under the Electoral College system three men gained the presidency even though other candidates had a larger popular vote. These were John Quincy Adams,

Rutherford B. Hayes, and Benjamin Harrison. Adams was elected by the House of Representatives when the Electoral College gave no candidate a majority. A special electoral commission decided the disputed election of Hayes and Tilden in favor of Hayes. The states that Harrison carried had enough electoral votes to give him a majority in the Electoral College, though Cleveland had beaten him in the popular vote.

In addition to these three presidents, several others have gained the office without receiving a majority of the total popular vote. Polk, Taylor, Buchanan, Lincoln, Garfield, Cleveland, and Wilson were also "minority presidents," because they had a minority of the popular vote though they had a

majority in the Electoral College.

The date of the presidential inauguration is now January 20, instead of March 4, as it was until the 20th amendment went into effect in October 1933. In taking the oath of office before the chief justice of the Supreme Court the president pledges himself to "preserve, protect, and defend the Constitution of the United States." He is specifically empowered to be commander-in-chief of the army and navy, to commission "all the officers of the United States, fill all vacancies that may happen during a recess of the Senate, to call extra sessions of Congress, to make treaties (provided two-thirds of the Senate concur), to reprieve and pardon offenders against the United States, and—with the advice and consent of the Senate—to appoint ambassadors, Supreme Court justices, and other federal officials whose appointments are not otherwise provided for by the Constitution.

In the early history of the country, people regarded the president more as a protector of the Constitution than as the leader of the nation. The present trend, however, is to look more and more to him for leadership. This dependence upon the president is an approach to the strong, highly centralized gov-

ernment favored by Alexander Hamilton.

The president does not have the right to introduce bills into Congress. He can, however, through his annual message to Congress, or a special message, suggest measures for it to consider. He also exercises considerable power over legislation through the veto (see Veto).

The president's chief advisors are the members of his Cabinet. They are appointed by him, with the advice and consent of the Senate, and are responsible to him only and may be removed by him at any

time (see Cabinet).

The Constitution provides that if the president is removed by death or other cause, his place shall be filled by the vice-president. Congress legislated in 1886 that if neither of these men can act as chief executive, the office shall then go to the cabinet members, in an order fixed by law, the secretary of state heading the list.

The salary paid to the president is normally \$75,000 a year. This amount is much smaller than that paid to the heads of other great nations, but it is sup-

plemented by use of the White House as residence, and by special appropriations which sometimes amount to \$450,000 annually for official expenses.

The president can be removed from office only by impeachment (see Impeachment). The only president who has been impeached was Andrew Johnson, in 1868; but the two-thirds majority vote required for conviction was not obtained (see Johnson, Andrew). The president cannot be arrested for any crime while in office. But once he leaves office, he may be tried and punished for any crime he may have committed while president.

The electoral votes cast by each state to elect a

president are as follows:

Alabama11	Nebraska 6
Arizona 4	Nevada 3
Arkansas 8	New Hampshire 4
California	New Jersey16
Colorado 6	New Mexico 4
Connecticut 8	New York
Delaware 3	North Carolina14
Florida	North Dakota 4
Georgia12	Ohio
Idaho 4	Oklahoma10
Illinois	Oregon 6
Indiana	Pennsylvania35
Iowa	Rhode Island 4
Kansas 8	South Carolina 8
Kentucky11	South Dakota 4
Louisiana	Tennessee12
Maine 5	Texas23
Maryland8	Utah 4
Massachusetts16	Vermont 3
Michigan	Virginia11
Minnesota11	Washington 8
Mississippi9	West Virginia 8
Missouri	Wisconsin12
Montana	Wyoming 3
	-
TOTAL	

(For a table of the presidents, see President in the Fact-Index. For statistics of presidential elections, see United States in the Fact-Index.)

PRETENDER. Any claimant to a throne, and especially an heir of a deposed line, is called a"pretender." The name is most commonly used for two princes of the exiled Catholic branch of the English house of Stuart. James Stuart, the Old Pretender (1688-1766), was the son of James II, who was unpopular because he was a Catholic and a despotic ruler. When James Stuart was born, the people, fearing that the young prince on coming to the throne would continue Catholic rule, drove the king into exile in France. (See James, Kings of England.) But upon his death in 1701, a French herald proclaimed the 13-year-old boy "James III, king of England and Scotland." The French court accorded him full honors and many English and Scottish nobles (called "Jacobites" from the Latin Jacobus for "James") remained faithful to him. Had he renounced the Catholic religion he might have gained the throne, but he would not give up his faith. His attempt to invade Scotland in 1715 failed.

His son Charles Edward (1720–1788), called the Young Pretender and Bonnie Prince Charlie, landed in Scotland in 1745 and took Edinburgh with the help of the Highlanders. Other Jacobites joined him,

and he even reached Derby, in England, 130 miles from London. But there his forces were obliged to turn back and were soon scattered.

The Duke of Cumberland followed the Pretender's Highlanders into Scotland and inflicted a terrible and bloody defeat upon them in the battle of Culloden Moor, about five miles from Inverness. The relentless cruelty with which Cumberland slaughtered the helpless fugitives and wounded gained him the name of the Butcher.

Prince Charlie's own escape presents one of the most thrilling stories in history. When capture seemed inevitable he was rescued by a brave Scottish girl, Flora Macdonald, who took him with her, in the disguise of a woman, past the line of eager sentinels. A reward of \$150,000 was placed on his head, and hundreds of persons were in the secret of his whereabouts; but none betrayed him. After five months' wandering about western Scotland, he reached a French vessel and escaped to the Continent. This was the last real attempt to restore the Catholic branch of the Stuart line to the English and Scottish thrones, from which it had been deposed in 1688.

PRIMARY ELECTIONS. At the close of the 19th century there was a general revolt in the United States against the way party politics were being conducted. Out of this grew the direct primary. The aim of the primary, or "nominating" election is to give the people a fair chance to select candidates for office. For years candidates had been selected at conventions. But with the growing indifference of the general public toward governmental affairs, these meetings, called party caucuses, were attended by fewer and fewer persons, and delegates were chosen largely by the party bosses.

Wisconsin, in 1903, was first in adopting a state-wide primary law. The movement spread until today practically all states have adopted the primary to nominate local, county, and state officers, and members of Congress. In some states it is used to express a preference for presidential candidates also. Details of the system vary, but in most states names of candidates are put on the ballot by petitions signed by a certain number of political supporters. For the most part nomination goes to the candidate receiving a plurality of votes, but some states require a percentage of the total vote cast.

Some primaries are "open" and some are "closed." At the open primary the voter is given the ballots of all parties and is allowed to mark the one he wishes. Most states use the closed primary. Here an effort is made to restrict voting for party candidates to members of that party. The difficulty arises in determining just who are members, at the same time allowing for changes in party allegiance. There are different methods in different states. Sometimes the intention to support the nominees of a party at the next election determines party membership. Or it may be decided by the person's vote at the last election, or by his answers to questions which the party prescribes.

The direct primary has not proved a panacea for all the ills of party politics, but it offers an opportunity to defeat a conspicuously unfit candidate or to nominate one conspicuously well fitted. It is an opportunity, not a cure, and it places the responsibility for securing good candidates upon the voter.

PRIMROSE. The yellow English primrose is usually associated with Lord Beaconsfield, for he loved this dainty flower above all others. At his death a wreath of its blossoms was sent by Queen Victoria to be placed upon his coffin, and the primrose has since become the emblem of the British Conservative party. Springing from amid the broad hairy leaves, the delicately fragrant yellow blossoms grow singly on long stems, blossoming during April and May. Many varieties of the primrose are in cultivation both in Europe and in this country, their blossoms ranging from bright yellow to the deepest purple. Altogether the primrose genus contains about 150 species, 13 of which are natives of North America.

Scientific name of the common English primrose, *Primula vulgaris*. Flowers pale yellow, an inch across, growing on separate stalks as long as the leaves; calyx tubular, 5-toothed; corolla salver-shaped, 5-lobed; 5 stamens; leaves tufted and wrinkled.

PRINCE EDWARD ISLAND, CANADA. You could put this little island province almost 300 times over into its huge neighbor Quebec; yet it remains an independent unit of the Dominion, admitted in 1873. The entire area is only 2,184 square miles. The width varies from 4 miles to 30, and the length is about 120 miles. It is by far the smallest of the Canadian provinces, and the most densely populated. It lies in the southern arm of the Gulf of St. Lawrence, tempered from the extreme cold of its latitude by the warming waters of the Gulf Stream.

It is a peaceful region with an air of quiet well-being. The towns have a prosperous look with their clean streets, painted houses, and cropped lawns. The countryside, which is a series of rolling plains, is well farmed and picturesque. The land is so fertile that it has been given the name of "Garden of the Gulf." It is famous for its production of oats and potatoes. Grazing also is important. Animals and animal products provide one of the island's greatest sources of wealth. Next to agriculture, fur farming, especially silver fox, and fishing are the most prosperous occupations. Lobsters, smelts, cod, herring, and oysters are the leading items of the catch.

Automobile and railway car ferries connect the island with the mainland. Charlottetown, the capital (population, 12,361), is situated on an excellent harbor and absorbs most of the trade of the province. In summer the island is a paradise for tourists.

Historians differ as to who was the first visitor to this island. Some say Cabot sighted it in 1497, others give the honor to Jacques Cartier, who sighted it in 1534. It was called Isle of St. Jean until 1798, when it was given its present name. It was a French possession until its final cession to the British in 1763. Population, 88,038.

into PRINT WORDS MARCHED How

First of All, the Letters that Form Them Had to be Cast in Movable Type So that They Could "Line Up" Properly, Like Well-Trained Soldiers-History of the Art that Serves All Arts

PRINTING. Anyone who cares for books must feel a curiosity about their origin. When was the first book printed? Who invented the process? These are difficult questions. No answer is possible if you include among books the curious volumes on tissue paper that are still used by the Chinese. Their origins are hidden in antiquity. Examples of Chinese printing survive today which bear a date corresponding to 868 A.D. These of course were not necessarily the first to be produced. But books like this are quite different from those that we commonly use today.

The Chinese workman who made them took a block of soft wood and carved away its surface until there remained ridges corresponding to the characters that he wished to reproduce. He coated these ridges with a watery ink, laid over it a sheet of porous tissue paper, and smoothed that flat with a stiff brush or a burnisher. When he peeled this off he found upon it a clear transfer in ink of the characters he had carved. This process is known as "block printing." No one

knows when it began.

The earliest surviving European print bears the date 1418, but it is believed that wood blocks were used in Europe as early as 1350. Printed impressions of engravings on copper were known in Italy soon after 1400. (See Engraving and Etching.)

Printing from Movable Type

But if one means by a "book" only the modern form that we use in the West the question is quite different. Our books are printed from movable type. The printing surface is composed of many tiny pieces. each of which has on its upper face a projecting letter form. The printer selects them from his case so that they spell out, letter by letter, the words that he wishes to print. When he locks these types firmly in a rigid frame, he has in metal what the Chinese workman had in wood—a flat oblong block on whose upper surface tiny projecting ridges correspond to the marks that are to be reproduced upon paper. He dampens this with an oily ink, lays a sheet of paper upon it, and slides it under a press. After he has applied pressure he peels the paper off and finds upon it an exact imprint of the printing surface. In block printing the characters carved for one page could not be used upon another. With movable type the individual letters can be removed and distributed in a case. where they remain ready for repeated future use. Printing by this method is an independent European invention. It has no apparent connection with the earlier Chinese discovery, although it was also used in China, along with block printing, as early as 1041.

We do not know exactly where or when the first printing in Europe was produced. No examples are left that can be definitely dated before 1400 A.D. By

1500 A.D. it was very common. All of our earliest specimens come from the Rhine Valley. We are therefore quite certain that European printing was a German invention and that it took place not long before 1450. There is a persistent tradition that Johannes Gutenberg, a citizen of Mainz, Germany, invented the process and made the first book. The truth of this is denied by some historians (see Typography).

The earliest examples of European printing preserved in our museums furnish evidence that cannot be questioned. These show that both processes block and type printing—were being used in the early 15th century. Of the surviving single-page imprints produced by the block method, the earliest to bear dates are pictures of (1) the Virgin Mary, in Brussels (1418); (2) St. Christopher, at Manchester, England (1423); and (3) St. Sebastian, at Vienna (1437). Of extant books, made by the block process, the earliest to which a date can be assigned is an Almanac for the year 1439. We may suppose that it was printed late in the year 1438 but the place is unknown.

The Earliest Books

Of books printed from type our earliest specimen is a fragment of an Almanac for the year 1448. This is preserved at Wiesbaden, Germany. Our next oldest dates are in certain printed church certificates (Indulgences), of which several examples survive. We know that these were intended for use in the year 1454 because these figures are printed on them and a blank space is left for the day and month to be supplied with the pen, as on a modern bank check. The first complete book to state the year of its printing is a Psalter in Latin, for choir use. This was produced at Mainz by Johann Fust (or Faust) and Peter Schoeffer. and its last page was set Aug. 14, 1457. Ten complete copies and several fragments survive. Fust was a wealthy citizen of Mainz from whom Gutenberg had borrowed money over a period of four or five years, and Schoeffer was one of Gutenberg's workmen.

There are also many pieces of printing which we can assign to no definite year. Some of them are of cruder workmanship than even the Almanac of 1448. Presumably they are earlier. Of the complete books that bear no dates, one, at least, is earlier than the Psalter of 1457. This is an edition of the Bible in Latin, which is commonly called the 42-line or Gutenberg Bible. Forty-one complete copies and numerous fragments are preserved. The vellum copy in the Bibliothèque Nationale at Paris carries a manuscript note by the rubricator that he completed his work on Aug. 24, 1456. Collectors prize copies of this Bible highly because it is commonly regarded as the first book printed in Europe. A copy is now in the Library

of Congress at Washington.

Historians who accept the Gutenberg tradition believe that not only this Bible but also all earlier imprints were the work of Johannes Gutenberg of Mainz. Some authorities uphold the rival tradition which ascribes the invention of printing to Laurens Coster of Haarlem. Still others reject both traditions because of a belief that no single man could have conceived the original idea and worked it out to successful application. It is reasonable to suppose that so complicated a process as printing must have required a slow and gradual development. (See Books and Bookmaking.)

The 42-line Bible and the 1457 Psalter are clearly the products of a highly developed technique. The Psalter, in particular, is a more elaborate work than an ordinary printer today could produce single-handed. Its ornamental initials surrounded by a delicate filigree pattern are printed in red and blue, while the text is in black. The register of these colors, that is their location on the page, in three successive impressions, is very exact. Colored newspaper supplements are always inferior in register to this Psalter; if one examines them closely the red, the blue, and the yellow will be found inaccurately printed.

We may be quite certain that printing from type was first successfully practised in the Rhine Valley, probably at Mainz by the year 1450. From there it spread with astonishing rapidity. From surviving specimens we can be certain of its introduction into various countries at the latest by the year indicated: Italy, 1465; Switzerland, 1466; Holland, 1469; France, 1470; Belgium, Austria-Hungary, and Spain, 1473; England, 1476; Denmark, 1482; Sweden, 1483; Portugal, 1487; Montenegro, 1493; Turkey, 1494. But in any particular case, our data may not go back to the beginning.

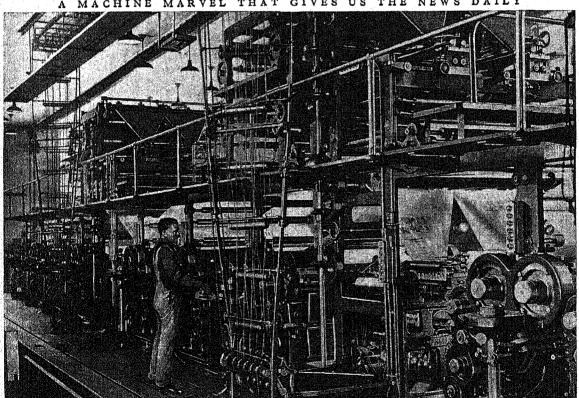
Before 1450 every European book was a pen-written manuscript. Within the next 50 years over 8,000,000 books had been printed. We know of 1,125 printing establishments operated in 259 cities before the close of the century.

Printing Transformed Civilization

The invention of printing was one of the three events taking place in the 75 years between 1450 and 1525 which transformed European civilization. The others were the discovery of the New World and the Protestant Reformation.

The early printing presses were crude wooden affairs in which a "platen" was screwed down to press a moist sheet of paper against an inked "form" of type resting in a bed; the combination provided the name "bed-and-platen" presses. In later types the platen

GIVES US THE NEWS DAILY MACHINE MARVEL



The newspapers and magazines of today with their enormous circulations would be impossible without the aid of such mechanical giants as this. A "rotary perfecting" press of this character will print 36,000 twenty-four-page newspapers or sections of newspapers an hour, all cut and folded ready for delivery. It took nearly 500 years of progress to bridge the gulf between this marvel of mechanical ingenuity and the Gutenberg hand press.

was made stationary and a movable form was pressed against it. The type was inked by patting it with stuffed feather balls daubed in thick printer's ink. This was a slow, tedious process.

In 1804 the first iron press was built in England by the Earl of Stanhope, and hand presses operated by levers instead of screws were invented in America. These latter were similar to the "Franklin" and "Washington" hand presses still seen in some small shops. Inking by gelatin rollers was the next big advance. Then the first rotary "cylinder" presses, operated by steam power, were built in England by two Germans, Frederick Koenig and Andrew Bauer, and were put in service by the London Times in 1814. In these machines the type form moved under the cylinder on a flat bed.

The Continuous "Web" Press

In 1865 William Bullock of Philadelphia invented a press "fed" by a continuous roll or "web" of paper. His device had two cylinders carrying the impressions and two roller cylinders. These are the "web presses" of today, except that Bullock's machine cut the paper before the printing, while now it is cut after the printing. Before Bullock's improvement the paper had been fed to the machines in sheets. Curved stereotyped plates came in 1868, and the first folders for such presses were invented in England in 1870. Before that a machine on which the type was locked to a cylinder had been invented by the Hoe brothers of New York— Robert, Richard, and Peter—and their associates. The Hoe Company contributed greatly to the development of the press after taking over the patents of a Boston pioneer, Isaac Adams, who had invented many improvements in the 1830's. The company was among the first to perfect presses which printed on both sides of the paper in one instead of two operations. About 1880 paper was improved to stand the pull of the presses without being dampened. This again added to the speed of printing.

The Modern Printing Press

From all these and other improvements we have our marvelous modern "perfecting" presses, which print, fold, paste, and deliver whole newspapers from continuous rolls of paper, sometimes turning out 300,000 large-sized papers in an hour. This output is the work of many presses, often built one above the other, each press called a "unit" and each fed by a separate roll of paper. Four, six, eight, or more units may be combined to make presses called quadruple, sextuple, octuple, etc. Few machines are as complicated or costly as these giants. Many of them carry "color decks," by which one, two, or many pages of a newspaper can be printed in colors while the rest of the pages appear in black and white. The paper travels through the press but once.

Magazine presses for high-grade printing and firstclass color work have also improved vastly. Much of this work is done on a flat-bed press called the tworevolution press, because the cylinder rises after each revolution to deliver the sheet while the form is being inked. Robert Miehle, an American, brought this type of machine to a high degree of perfection as early as 1883. The Goss Company of Chicago also has contributed much to the perfection of these and the giant high-speed color presses used by newspapers.

Censorship and the Press

The invention of printing brought with it new problems in controlling the expression of religious and other opinions. In 1515 the Church Council of the Lateran, held in Rome, decreed that no book should be printed unless it was previously approved. usually by the bishop of the diocese. In 1559 there was drawn up an 'Index' or list of prohibited books which should not be read by good Catholics without special permission; this 'Index' has been revised and new titles have been added from time to time. During the tyranny of the Stuart kings in England, a general censorship of the press was established in 1637, and later confirmed by Parliament. This Licensing Act expired in 1693, and since that date England has had no censorship. In France a rigid censorship of the press lasted until the French Revolution and was revived by the restored Bourbons after 1815. Elsewhere in Europe censorship lasted even longer. The first amendment to the United States Constitution. adopted in Congress the same year that the government began, provided that Congress should have no power to pass any law "abridging the freedom of speech or of the press." Many court decisions have upheld it. (See also Electrotyping; Engraving; Linotype; Monotype; Newspapers; Stereotyping.)

PRISONS AND PUNISHMENTS. As soon as firm governments had become established in the world, men began to realize that crime was not simply an injury to a private individual, but an injury to the state itself. The state imposed certain duties upon its citizens and in return it was bound to protect their lives and their property. The murderer or thief who killed or robbed a citizen became a public enemy, and it was therefore the state's duty to apprehend, try, and

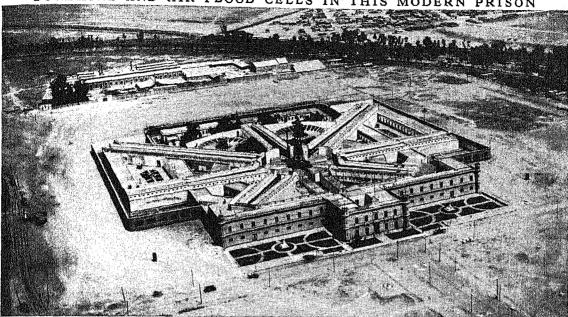
punish the criminal.

For ages punishments were inflicted chiefly in the spirit of the Mosaic law of retaliation, "an eye for an eye and a tooth for a tooth." Offenders must be made to "pay" for their crime by their own sufferings. While this feeling has not entirely died out in the popular mind, the laws of all civilized states have abandoned the idea of vengeance. Punishments are imposed now for three reasons: (1) to protect society from criminals by putting them out of the way, either by death or imprisonment; (2) to discourage others from committing crimes by showing them the fate that awaits the criminal; (3) to reform the criminal.

The Use of Torture

Until comparatively modern times, torture was used not only as a punishment but to extract confessions from the accused and to get evidence in legal trials. The practise of torture was supported by Aristotle, the great Greek philosopher, and elaborately regulated in Roman law, which became the basis for all the

SUNSHINE AND AIR FLOOD CELLS IN THIS MODERN PRISON



Mexico's model penitentiary at Mexico City has a series of cell houses extending from a central circle like the spokes of a wheel. This construction gives each prisoner plenty of light and air in his individual cell. Guards are stationed in the great floodlight tower in the center and in the other towers seen at various corners of the wall.

gruesome medieval legislation of Italy, Spain, France, and Germany. In England torture was not authorized by common law, but in the days of the Tudors and Stuarts it was practised under royal prerogative. Condemned men were executed in the most painful ways imaginable. Burning at the stake was the penalty for certain offenses as late as the 18th century. At various times criminals were crucified, stoned to death, buried alive, torn apart by wild horses, thrown to wild beasts, or made to suffer other horrible deaths. Frequently prisoners were tortured for days before their execution, which was generally public.

Methods of Execution

The usual methods of execution among Europeans and Americans today are electrocution or killing by an electric shock, practised in some parts of the United States; hanging, the principal method in the United States and England; beheading, especially by the guillotine, which is used in France; and shooting, the method employed in Latin-American countries.

In the last century the number of crimes for which death is inflicted has been greatly reduced. Students of criminology have reached the conclusion that it is not so much the severity of punishment which puts a stop to crime as the certainty of punishment. If all criminals felt sure that they would be caught and sent to prison, it would frighten them more than to see a few criminals hanged, while others equally guilty escaped altogether. In 1765 in England there were, according to Blackstone, no less than 160 offenses for which a man might be put to death, extending from the gravest crimes to petty thefts. Today, in nearly all civilized countries, capital punishment (as the

death penalty is called) is used for only two crimes—treason, and murder in the first degree.

For minor offenses there were formerly certain forms of punishment such as flogging, branding with a hot iron, and mutilation, which are scarcely less repugnant to modern feeling than the medieval torture chamber. Scolding housewives were punished by the ducking-stool, an instrument something like a long well-sweep by which the victim was repeatedly ducked in a pond. For such offenses as seditious libel, especially in books published without license, giving short weight, and brawling, favorite instruments of punishment in England or the American Colonies were the pillory and the stocks, which pinned the victim's wrists or ankles while he was exposed to derision in a public place. The pillory survived as a legal punishment in Delaware until 1905, and the whipping-post is still employed there. But today these forms of punishment have virtually everywhere in civilization given way to the modern penalties of imprisonment or money fines.

When the practise of inflicting prison sentences first took root, during the 16th and 17th centuries, the condition of the prisoners was deplorable in the extreme. Prisons were dark fever-breeding filthy dens, in which men, women, and children were crowded together without ventilation, and with virtually no food except what friends supplied or the jailers furnished for pay. Scarcely less wretched was the lot of those who were deported to distant colonies and forced to labor on plantations.

The credit for rousing the public conscience to the barbarism of such conditions belongs chiefly to the Englishman John Howard (1726-1790), whose horrifying pictures of prison life forced a change in the treatment of offenders. Scarcely less influential was the work of Elizabeth Fry (1780-1845), a Quaker preacher, who spent much of her life ministering to unfortunates in prison. A similar work was done in the United States by a group of Philadelphia Quakers, who began agitating for prison reform immediately at the close of the Revolutionary War, and in 1787 founded the parent prison reform society. Their efforts bore fruit before those of the English reformers, so that the United States became the first country to set an example to the world of really humane treatment of criminals. The American prison system, now in almost universal use, embodies two main principles: the separation of prisoners by individual cells, and their employment at some form of labor.

How Prison Terms Can Be Shortened

Today a convict can often shorten his term by good behavior, or upon recommendation by the proper authorities he may be released "on parole." This means that he is freed if he agrees to remain in the same state, to avoid bad habits, and to report at intervals to parole officials. Sometimes "deferred sentences" are imposed; this means sentence is imposed but not enforced so long as the offender's conduct is satisfactory. "Indeterminate sentences," now given in many states, set the term within certain limits, as one to ten years, depending on good behavior and the decision of a parole board.

If it appears that a prisoner has been unjustly convicted, he may be pardoned by the governor of the state. Most states have pardon boards to investigate appeals for pardons and report to the governor.

Young offenders are sentenced to reform schools. Here they are taught trades, and an effort is made to surround them with good influences so that they may return to useful life; but many habitual criminals are found to be "graduates" of reformatories.

Most students of criminology favor changes in the present system. Almost all urge a flexible sentence, with no definite time limit. Psychiatrists on the prison staff would investigate a prisoner's family background and life environment, assign him to his proper group in prison, and then study his mental reactions and conduct. He would be freed only when the psychiatrists decided he was "cured" of his criminal tendencies. Hopeless cases would be confined permanently. Since many become criminals in youth, psychiatrists urge that every effort be made to help first offenders adjust themselves to normal living, perhaps in the home under the direction of medical and court authorities. Similarly, as many mentally backward children become criminals, such children should have proper care. (See Mental Deficiency.) **PROHIBITION.** From almost the dawn of history

PROHIBITION. From almost the dawn of history, men have made laws to restrict the sale and use of liquor. More than 4,000 years ago, the Babylonians sought to control tavern keepers, and laws to this end were included in the code of Hammurabi.

In America, restrictive legislation on liquor goes back to the earliest Colonial days. Massachusetts Bay Colony in 1633 forbade the sale of "strong water to any Indian." At the instance of Governor Oglethorpe the importation of rum and other spirits into Georgia was forbidden in 1733. In all colonies there were laws for the license and regulation of taverns, import duties, and other measures of control.

With the opening of the 19th century, anti-liquor sentiment grew rapidly; but people generally regarded the liquor traffic as something to be controlled rather than prohibited, and they fought its evils by working for more drastic restrictive laws. The movement for the prohibition of liquor—that is, for the enactment of laws to prevent its manufacture and sale—did not arise until almost the middle of the century. The movement gained momentum in 1851 when Maine passed a state-wide prohibition law, which replaced an earlier (1846) but weaker statute. By 1855, twelve other states had enacted prohibition laws.

Prohibition Sentiment Grows

Political opposition to these laws and the difficulty of enforcing them soon brought about their repeal in most of the states that had adopted them. In many parts of the country, however—particularly in agricultural regions—prohibition sentiment continued to grow. The National Prohibition Party was formed in 1869 to secure state and national legislation against the manufacture and sale of liquor.

The lead in the drive against liquor was later taken by the Anti-Saloon League, which became a national organization in 1895. The original purpose of the league was the abolition of the saloon. It thus had the support not only of total abstinence believers but also of those who, while not total abstainers, believed that saloons were a menace to the nation. The league worked to secure enactment of "local option" laws. These were laws which gave the voters in the villages, towns, townships, cities, or counties of a state, the right to decide by majority vote if liquor should be sold in the political division where the vote was taken.

With prohibition districts thus established, the next step was to secure enactment of state-wide prohibition. In 1913, the league began to work for national prohibition. At this time there were nine prohibition states. Four years later there were 26 states which had adopted total or partial prohibition.

National Prohibition Adopted

In December 1917, after the United States had entered the World War, Congress passed the Webb resolution to submit to the states a national prohibition amendment. The last of the required 36 states ratified the article Jan. 16, 1919, making the amendment effective one year from that date. The Volstead Act to enforce this amendment (the 18th) was passed Oct. 28, 1919, over President Wilson's veto.

For more than a decade the United States was a prohibition country; then, on Feb. 20, 1933, Congress passed the Blaine resolution to submit to the states the 21st amendment, which was to repeal the 18th amendment. This was ratified within a few months, and thus ended what President Hoover called the "greatest social experiment in history"—the experiment of national prohibition.

Prohibition and Liquor Control Abroad

Though the United States was the leader in both the temperance and prohibition movements, Iceland (1908), Sweden (1909), Greenland (1918), and Finland (1919) preceded it in enacting national prohibition. Sweden voted repeal in 1922, Finland in 1932, and Iceland in 1933.

Other countries have moved along the line of increased control and taxation of the liquor traffic, rather than prohibition. Great Britain has limited the number of hours during which liquor can be sold each day. In Turkey, Switzerland, Russia, and some of the Canadian provinces, the sale of spirits is a state monopoly. In Sweden and Norway spirits may be sold only by companies which are licensed by the government and have to turn their profits over to it. In Sweden consumers are allowed to purchase only a limited amount monthly. (See also Temperance; Woman's Christian Temperance Union.)

PROMETHEUS (prō-mē'thūs). The Greeks were one of the first peoples to picture a hero who, at the cost of suffering to himself, helped to make humanity's condition better. Prometheus, their legend told, was one of the Titans, a mighty race of demigods. When men had fallen into a brutish state and the wrath of Zeus was aroused against them, Prometheus came forward as their champion. He uplifted them, taught them the useful arts, and even stole fire from heaven in a fennel stalk for their use. For this Zeus punished him by chaining him to a lonely rock on Mount Caucasus. Here he remained for ages, while a vulture devoured his liver, which grew again by night, thus prolonging his torture. He possessed a secret which threatened the rule of Zeus and for which Zeus offered him his freedom, but Prometheus refused. He chose rather to endure his torment until the appointed time, when he was released by Heracles (Hercules).

The story of Prometheus has inspired many poets, both ancient and modern. One of the greatest Greek tragedies, the 'Prometheus Bound' of Aeschylus, describes powerfully and dramatically the strength of the hero and the awful torture which he endured.

PRONOUN. Pronouns—words used in place of nouns—save us a great deal of wearisome repetition in writing and speaking. Instead of naming over and over again the persons or things we are talking about, we use such short words as you, he, she, it, them, etc.

The most important kind of pronoun is the personal pronoun. A personal pronoun indicates grammatical person by its form alone; as, *I*, we, you, your, them, it. In grammar the term person means the property of showing whether a word refers to (1) the speaker, (2) the person or thing spoken to, or (3) the person or thing spoken of. The word is thus said to be the first, second, or third person; as first person, *I*, second

person, you; third person, he. Other kinds of pronouns are also said to be in the first, second, or third person, according to their meaning in a sentence. For example, the pronoun who is in a different person in each of the sentences that follow: "I who speak unto you am he" (first person); "You who listen must decide" (second person); "The boy who works will succeed" (third person). The personal pronoun, however, is the only kind that shows grammatical person by its form, when standing alone. Besides person, pronouns also have the other properties which belong to nouns; gender, number, and case (see Nouns).

Other important kinds of pronouns are the interrogative, the demonstrative, and the relative or conjunctive. An interrogative pronoun is a pronoun used to ask a question; as, "What is that?" A demonstrative pronoun is one that points out some particular person or thing; as this, that. A relative or conjunctive pronoun is a pronoun used to join a clause to a substantive; as, "It's a long lane that knows no turning." Who, which, and that are the most common relative pronouns. (It should be noted, however, that each of these words has other uses.)

The "How" of "Who," "Which," and "That"

The relative pronoun who should always be used to refer to persons: the relative pronoun which should always be used to refer to things or ideas; the relative pronoun that may refer to either persons, things, or ideas. A relative pronoun has two uses in the sentence; as a connective it joins its clause to its antecedent, that is the word to which it refers; as a pronoun it is used in this clause like a noun. In the sentence above, the relative pronoun that joins the clause "that knows no turning" to the pronoun it, and is used as the subject of the clause. If in doubt as to the use of a relative pronoun in its clause, substitute the antecedent, making the clause a separate sentence; as, "The boy who, we thought, was good for nothing became a daring aviator"; or "The boy whom we thought to be good for nothing became a daring aviator." In the first sentence who is subject of the clause, and we thought is thrown in parenthetically; in the second sentence whom is subject of the infinitive phrase to be good for nothing, and with it is used as the direct object of the verb thought. This is proved by substituting the antecedent boy: "The boy, we thought, was good for nothing"; "We thought the boy to be good for nothing."

Different Forms of Pronouns

Five personal pronouns, and the relative or interrogative pronoun who, each have separate forms for the nominative and the objective cases, as follows: I, me; he, him; she, her; we, us; they, them; who, whom. Also the old-fashioned forms thou, thee; ye, you are still occasionally used. They also have possessive forms, which are sometimes called possessive adjectives; as, "My book, your dog, his duty, their pleasure," etc. Some of the personal pronouns have separate possessive forms which are used when the pronoun is to stand alone; as mine, yours, hers.

The declensions of the personal pronouns are as follows:

Nom. I we Poss. my, mine our, ours Obj. me us SECOND PERSON Singular Plural Nom. you (thou) you (ye) Poss. your, yours (thy, thine) your, your Obj. THIRD PERSON you THIRD PERSON Singular Plural Nom. he she it they			First Pers	ON	
Poss. my, mine our, ours Obj. me us SECOND PERSON Singular Plural Nom. you (thou) you (ye) Poss. your, yours (thy, thine) your, your Obj. you (thee) you THIRD PERSON Singular Plural Nom. he she it they Poss. his her, hers its their, their			Singular		Plural
Obj. me us SECOND PERSON Singular Plural Nom. you (thou) you (ye) Poss. your, yours (thy, thine) your, your Obj. you (thee) you THIRD PERSON Singular Plural Nom. he she it they Poss. his her, hers its their, their	Nom.		I		we
SECOND PERSON Singular Nom. You (thou) Poss. Obj. Masc. Nom. he She Plural you (ye) your, yours (thy, thine) your, your THIRD PERSON Singular Fem. Neut. All Genders Nom. he She it they Poss. his her, hers its their, their	Poss.		my, mine		our, ours
SECOND PERSON Singular Nom. You (thou) Poss. Obj. Masc. Nom. he She Plural you (ye) your, yours (thy, thine) your, your THIRD PERSON Singular Fem. Neut. All Genders Nom. he She it they Poss. his her, hers its their, their	Obj.		me		us
Nom. you (thou) you (ye) your, yours (thy, thine) your, your your you you you you you you you THIRD PERSON Singular Fem. Neut. All Genders Nom. he she it they Poss. his her, hers its their, their				BON	
Poss. your, yours (thy, thine) your, your your you file) THIRD PERSON Singular Masc. Fem. Neut. All Genders Nom. he she it they Poss. his her, hers its their, their			Singular		Plural
Obj. you (thee) you THIRD PERSON Singular Singular Fem. Neut. All Genders Nom. he she it they Poss. his her, hers its their, their	Nom.		you (thou)		you (ye)
THIRD PERSON Singular Masc. Fem. Neut. All Genders Nom. he she it they Poss. his her, hers its their, their	Poss.		your, yours (thy, thine)		your, yours
Masc. Singular Plural Nom. he she it they Poss. his her, hers its their, their	Obj.		you (thee)		you
Masc. Fem. Neut. All Genders Nom. he she it they Poss. his her, hers its their, their		100		ON	
Nom. he she it they Poss. his her, hers its their, their					
Poss. his her, hers its their, their		Masc.	Fem.		
	Nom.	he	she	it	they
Obj. him her it them	Poss.	his	her, hers	its	their, theirs
	Obj.	$_{ m him}$	her	it	them

The relative pronoun who has the same forms for both singular and plural: nominative, who; possessive, whose; objective, whom. The only other pronouns commonly inflected are this and that, which have as plural forms these and those.

Some difficulties in the use of pronouns arise from the failure to choose the right case-form, and from the failure to make a pronoun agree with its antecedent in number. The case of a pronoun is not determined by the case of its antecedent, but by its own use in the sentence (as we have seen in the examples given in the fourth paragraph of this article). It should be clearly understood that the case to be used when a sentence element is compound (see Sentence) is the same that would be used if the pronoun stood alone. Many people who would never say "Me did it" or "He brought it to I" will say "John and me did it" or "He brought it to John and I," instead of "John and I did it" and "He brought it to John and me."

The number and gender of a pronoun are determined by the nature of its antecedent. If the antecedent is of common gender, the masculine pronoun is used; as "Each of the children held out his hand." Each, every, either, neither, though they suggest always more than one, are singular when used alone or with singular nouns, since they always mean one at a time. Therefore singular pronouns should be used referring to them. In the sentence above, for example, "Each of the children held up their hands" would be incorrect.

Pronouns that Play Many Parts

Since pronouns represent persons, things, and ideas, without naming them, one pronoun may take the place of many different nouns. Hence in using them great care is necessary to make the reference of each pronoun immediately and perfectly clear. The pronouns this, he, it, and which are especially apt to be used indefinitely.

The correct use of pronouns is one of the surest marks of the careful writer and speaker. Probably the majority of people make errors in the use of these common words every day of their lives. Some of the mistakes to be guarded against are illustrated in these sentences:

"John was hungry, but it did not distress him so much as it did Frank." It is here used without a grammatical antecedent. The correct form would be: "John was hungry, but he was not so much distressed as Frank was.

"I can spell better than him." Him is incorrectly used for he. The nominative form is required, as the subject of the verb does, to be supplied.

"Those kind of books doesn't interest me." The pronoun should be in the singular, that, because it modifies the singular noun kind.

"Give me them skates." Them is a personal pronoun and cannot be used as a demonstrative pronoun to modify a noun.

"She is a girl who I know you will like." Who should be whom, since the pronoun is used as the object of the verb

"She is a girl whom I know will make good."

should be who, as the subject of the verb will make.

"The tree lost it's leaves." It's for its. Notice that the possessive forms hers, its, and theirs do not have the apostrophe before the s.

PROPHETS. We commonly think of a prophet as one who foretells future events, but as used in the Bible the word has a deeper meaning. In the Bible a "prophet" is one who speaks for God. Hebrew prophecy is sometimes said to begin with Moses, who in after-times was regarded as the first and greatest of the prophets. Others regard Samuel as the first of the prophets.

In a special sense the title belongs to those great Hebrew reformers and leaders who, in times when the people of Israel had fallen into evil ways, when they had given themselves up to idolatry or to the pursuit of material things, sternly and fearlessly rebuked them; or, in times of great national disaster. strengthened their faith by assuring them of God's mercy. Such a prophet was Elijah, who battled for Jehovah against the priests of Baal, and is represented as being carried up to Heaven in a chariot of fire, his mantle falling upon Elisha, his successor.

Later we find a succession of inspired leaders, who were writers as well as teachers and men of action, and whose words have come down to us in those parts of the Bible known as the Prophets. The first of these "literary prophets," as they are sometimes called, was Amos, a simple herdsman from Tekoa, who dared to denounce the men of wealth and power, living in luxury built upon the poverty of the people. Then came Hosea, pleading fervently with the people to remain faithful to Jehovah; and Isaiah, with his sublime vision of the day when the God of Israel should be worshiped by all the world.

Another great prophet was Jeremiah, who arose in the dark days before the Babylonian conquest. He was hated because he announced the impending doom of Judah, and was held to be a traitor because he set loyalty to God above loyalty to king and country. Jeremiah was followed by Ezekiel, who was among the captives carried to Babylon. Like other prophets, he was stern in condemning the wickedness of his nation, but he likewise brought consolation by picturing the new life that Jehovah would breathe into the dry bones of Israel.

The prophet Daniel is the hero of the biblical book which bears his name. Carried captive from Jerusalem to Babylon, he won the favor of King Nebuchadnezzar through his wisdom and ability to interpret dreams, and became one of the highest rulers in the

A GROUP FROM THE FAMOUS 'FRIEZE OF THE PROPHETS'



These figures from the 'Frieze of the Prophets' by John S. Sargent in the Boston Public Library represent, in the order named, Amos, Nahum, Ezekiel, and Daniel. This frieze is one of the most ambitious and original of the works of this great American artist and it is universally agreed that it deserves high rank among the works of moderns who have dealt with sacred subjects.

Babylonian kingdom. When "Darius the Mede" captured Babylon, Daniel continued in high position until jealous princes contrived to have him thrown into a den of lions, where he was miraculously preserved from the savage beasts.

The "Law" and the "Prophets" are two great divisions of the Old Testament as arranged by the Jews. The Law comprises the five books of Moses; and the Prophets consists of the "major prophets"— Isaiah, Jeremiah, and Ezekiel—and the 12 "minor prophets" (so called because of their brevity)—Hosea, Joel, Amos, Obadiah, Jonah, Micah, Nahum, Habakkuk, Zephaniah, Haggai, Zechariah, and Malachi. The remaining books are classed as "Hagiographa" or "Holy Writings"; the Book of Daniel is placed in the Jewish Bible in this last group. (See Bible; Jews.)

PROTECTIVE COLORATION. It seems plain that the most useful coloring for an animal whose life is spent in trying to avoid dangerous enemies would be the one in which it could least easily be seen; and countless races of animals have gradually obtained such a coat—sometimes in amazing perfection. The most unmistakable examples are to be found among the most helpless—those who have little or no other means of defense; and this seems to show that it is by this "safety first" feature that their races have managed to continue to live in a world of merciless warfare. Almost all the small swimming creatures in the sea, and the fry of many fishes, are transparent, so that they are quite invisible in water; a ribbon-shaped baby eel, for instance, is as clear as glass. Nearly all fishes, a group of animals whose only means of defense, as a rule, is in flight, are bluish on the back—a tint not readily seen under water. Inshore species, such as the anemones and worms between tidemarks, are the color of mud when their tentacles are withdrawn; and the ground-running insects, and bigger things in open spaces, such as the western horned toads, are the color of soil or sand, and easily overlooked. The same is true of the hosts of insects that live and feed amid the foliage of trees and bushes or in the grass, matching it by their green or green-mottled coats. Try to find a noisy katydid in an apple tree, and you will appreciate the difficulty of the search.

The Hunters and the Hunted

But, you may say, birds, wasps, and other hunters catch these hiders every day. So they do, but not so easily nor numerously as they would if their captives showed themselves scarlet on the ground or golden amid green foliage; and furthermore, their "disguise," so to speak, is serviceable only so long as they keep still. You have heard of the Oriental leaf-butterfly, the upper surface of whose wings is gaily painted, but when it alights, instantly folding its wings together above its back so that their streaked brown undersurface alone appears, it becomes so like a leaf that the sharpest-eyed natives pass it by unnoticed. Many a one has been surprised to have what seemed a scale of bark on a tree trunk spring into color and flutter away as a moth. So long as such a creature is motionless its similarity to what it rests upon keeps it fairly safe, but the moment it moves it is seen. In some young animals, for instance whippoorwill chicks, the instinct of trusting to immobility is so strong that you may pick them up from the woodland floor-if you can find them!

This brings out an important point, namely, that in most cases the "protected" animal is in no great danger when it is wide awake and active. It needs most the safety its color gives when it must rest or sleep or care for its young. Here is where protective coloration is chiefly of value to birds, and it explains why it is that in so many kinds of birds the female wears a very plain dress while her mate is gaudily feathered. The scarlet tanager, the black-birds, the grosbeaks, and the indigo-bird are familiar American examples. The gay fathers of the families can take care of themselves pretty well, for they are free to fight or flee when danger threatens; but the mothers must sit steadily on their nests, where they would quickly be seen and pounced on by some prowling cat or other bird-killer were they wearing bright colors. If this is true of those mentioned, which nest under the cover of leaves, how much more is it true of those, like the killdeer, whose nest lies on open ground. Not only does the mottled back of the sitting mother in such cases so blend with the earth and weeds about her that she usually escapes notice, but even her brown eggs are all but invisible when exposed by her absence. Such enemies as find the nest are probably guided by smell.

The grass-frequenting sparrows are streaked dark brown and buff or gray, like the dry grass in the fields; the bitterns are more broadly striped, like the cat-tails and sedges of the marshes; the grouse and woodcock are mottled brown and buff, like the dead leaves of the forest floor, etc.

But nature has gone even further than this. Artists have long known how to make objects stand out on the canvas by shading the under side to imitate a shadow thrown by a solid figure. The artist-naturalist, Abbott Thayer, has pointed out how the exact opposite of this principle is applied to birds and animals, causing them to become inconspicuous by destroying the appearance of shade on their underparts. This is brought about by their being colored lighter below, in exact proportion to the amount of shade received; so that they are practically pure white on the middle of the belly, with a gradual change to the dark upper parts. Furthermore, wherever else a shadow is thrown, as by the bill on the chin, that spot is colored much whiter. When the solid appearance of a bird is thus destroyed, if its color and pattern are those of its background, it becomes absolutely invisible at a short distance. This principle is called "counter-shading."

Another very different principle of protective coloration is that called "ruptive marks," in which conspicuous black and white marks are placed close together. Examples of this principle are found in the black bands across the white breast of the killdeer, and the white ring around its neck; and also that around the neck of the kingfisher and the mallard duck. Such marks seem to cut off the head of the bird, or to break up the bird into several pieces, thus destroying its continuity of form. In this way the eye of the enemy is attracted to some one part rather than to the bird as a whole, and it appears like something else. Both of these principles were used extensively during the World War of 1914-18, under the name of "camouflage," to conceal large guns, battleships, motor trucks, etc.

Banner Marks in Animaldom

A third method of protective coloration is called "flash colors" or "banner marks"; it is exemplified by such conspicuous marks as the white rump of the flicker, or the white outer tail feathers of the meadow-lark and other birds, which can be concealed or displayed at will. The white rump of the flicker, for instance, is very conspicuous in flight and would naturally be the target of any pursuing hawk. When the flicker claps up against a tree, however, closing its wings, this spot disappears, and the hawk is confused sufficiently to permit the flicker to slip around to the other side of the tree.

There is a way also in which likeness in color to its customary surroundings helps the hunter as well as the hunted. The method of capturing prey by ambush is common among beasts of prey, from the muddy crab in the eel-grass, or the weed-grown snapping-turtle, and the alligator looking like a

SIX EXAMPLES OF NATURE'S CAMOUFLAGE



The Nassau Grouper, like some other tropical fishes, turns dark when alarmed (1) and makes for a shadowy hiding place. Normally he is brilliantly colored (2). Can you find the Stick Insect (3), two Whippoorwills hiding (5), and seven Indian Leaf Butterflies (6)? In the center you see the tragic fate of a Peccary who mistook an Alligator's tail for a log.

PROTECTIVE COLORATION X Q TO TO TO

floating log, to the tiger, his stripes matching the streaks of sunlight and shadow among the tall grass; all are lurking until some unsuspecting victim comes near enough to be leaped upon. With no other dress could the ambush succeed.

PROTEINS (prō'tĕ-ĭnz). In order to grow and to repair the wear and tear that is constantly going on in the tissues, every living thing must have a constant supply of protein. Protein differs from all other kinds of food substances in that it alone contains the nitrogen that is necessary to life. It is the most important of all foods, and that is why it was given its Greek name, which means "of first importance."

However richly a man may be supplied with sugar, fats, starch, and salts, he cannot live without protein. And while sugar and fats are better fuel for the body, proteins supply fuel also, and maintain life

without fats or carbohydrates.

The greater part of the solid matter of all animal cells and tissues, and also various parts of the structures of plants, particularly the seeds, are made up of various kinds of proteins. Most plants—those that have green coloring matter, or chlorophyll—can make protein for themselves, but all animals and human beings and those plants which, like the mushroom, contain no chlorophyll, must obtain it readymade. There are nearly 40 different kinds of vegetable and animal protein, most of which are suitable food for us.

Some of the well-known members of the protein family are the gluten of wheat, albumen of eggs and meat, casein of milk, and legumin of peas and beans. The dried white of an egg is almost pure protein; so is the gummy mass left after wheat is chewed for a long time. Plant foods rich in protein are wheat, corn, oats, peas, beans, peanuts, lentils, and nuts. The animal sources of protein are meat, milk, eggs, and cheese.

The continued over-eating of protein, however,

may lead to very serious ills, for while we can store up as fat an excess of sugar and fats that have been taken into the body, we cannot store up protein. It must be used up at once, or broken up and expelled from the body. Now the breaking up of proteins in the body is difficult, as they are so very complicated in their chemical composition, and many of the products of the breaking-up process are poisons. to keep in perfect health it is necessary that our diet be well balanced, containing only the protein supply which we need, with a proper proportion of fats, carbohydrates, and mineral salts. (See also Food.) PROTEUS (prō'tĕ-ŭs). The ancient Shepherd of the Deep lay at noon in his hollow cave by the Ocean's shore, and all about him slumbered the well-guarded sea-calves, or seals, as we should call them, which the god Poseidon had intrusted to his care. But four of his flock had secretly been slain, and in their skins lay hidden King Menelaus and three of his trusted followers. These survivors of the great Trojan War

had come to wrest from Proteus the secret of the contrary winds which kept them from their far distant homes.

When Proteus, having counted his flock, lay down to rest, Menelaus and his men threw off the skins and seized him. Then Proteus' hair became transformed into a mane and his body into that of a raging lion. But his captors did not relax their grasp, for they knew his cunning wiles. Then he sought to writhe out of their hands as a snake. Next he became a leopard, and then a fierce wild boar. Even when he took the shape of running water and of a tall and flowering tree, they held him fast.

At last, wearied of the struggle, Proteus resumed his proper form and revealed to Menelaus how by sacrifice he might appease the wrath of the gods and be granted favorable winds to waft him homeward. When questioned further he told how Agamemnon, the brother of Menelaus, had met a treacherous death; and how fared the other leaders of the Greek hosts. Thus having prophesied, the ancient one was released and plunged into the depths of the sea.

Such is the story which Homer tells of Proteus. He was one of the many lesser divinities that followed in the train of the sea-god Poseidon (Neptune), and perhaps typifies the ever-changing aspect of the sea. His name has given us the adjective "protean,"

meaning "variable."

PROTOPLASM. The fairy godmother of every living thing—of plants and animals and ourselves—is a drop of magical jelly that we call protoplasm. It gets its name from two Greek words which mean "first material," because it is the "stuff" out of which every living thing is made.

This protoplasm is really the only thing in the universe which is alive. Plants and animals are alive, because they are made up of this wonderful life-substance, but minerals are not alive, because

they have no protoplasm.

What is it to be alive? A bit of cloth or blotting paper can soak up water, but it cannot use it or make anything out of it. A silkworm eats mulberry leaves, grows larger on this food, makes a silk cradle to sleep in, and then hatches out into a moth that lays more silkworm eggs. To be alive is to eat and grow, and turn the food into something else, and—don't forget this—make more living things like itself. That is why we know that the little drop of jelly is alive. It is the smallest, simplest live thing in the world. (See Biology; Cell.)

Chemically, protoplasm consists chiefly of carbon, hydrogen, nitrogen, sulphur, and oxygen. The scientist Huxley calls it "the physical basis of life." In active living cells protoplasm is usually a colorless bubbly thick fluid, which is seen under the microscope to be in ceaseless motion. In cells at rest, such as seed-cells, the protoplasm becomes much harder, sometimes as hard as bone. The thinner more watery protoplasm which surrounds the nucleus of

the cell is usually called cytoplasm.

PROTOZO'A. If you dip a glass of water from a stagnant pond and look through it toward the light you will see a multitude of tiny creatures so small that they are hardly visible. If you take a single drop of this water and examine it under a powerful microscope you will find that it contains a number of still smaller creatures. These are so small that a single drop of water is a whole world to them. They are the lowest forms of animal life and are called "protozoa," from the Greek words meaning "first life." Each one is a complete little animal, though it is composed of only a single cell.

One of the commonest of these single-celled animals is the amoeba (see Amoeba). Like a poor family that can afford no more than a single room to live in, the protozoa must do all their growing and living within the one tiny cell that forms their body. We get an idea of how small they are from the fact that a pint of water may contain millions of them.

Tiny as the protozoa are, some of them actually build a little house or shell for themselves out of lime or some similar substance which they make in their own bodies. These are the foraminifera. If you examine them under the microscope you will find that their shells are often just as intricate and beautifully made as the large shells you pick up by the seashore. Through centuries the little shells of the foraminifera have fallen to the bottom of the seas, and in this way our great chalk cliffs and beds have been formed. The infusoria make up another branch of the protozoa. They are equipped with hairlike swimming organs called cilia. Best known to beginners in biology is the "slipper animal," or paramecium.

There are other protozoa, also, which live as parasites on higher animals, including man, and often cause dangerous diseases. For instance, malaria, amoebic dysentery, sleeping sickness, as well as some other diseases, are known to be caused by forms of protozoa which find their way into the blood and other parts of our bodies. (See Bacteria; Cell; Germ Theory of Disease.)

PROVIDENCE, R. I. Between 1787 and 1841 Providence—like Boston, Salem, and Newport—was a busy port for the China and India trade. There were plenty of things that New England wanted from China-tea, coffee, muslins, silks; but there was little that China would accept in return except good solid coin, and gold and silver were scarce in old New England. Therefore the cargoes outward bound at first consisted chiefly of things brought in by other voyages from Sweden, St. Petersburg, France, Spain, Madeira, and the West Indies. Then it was found that China wanted also the wonderful furs obtained in America by trade with the Indians, and the difficulty was partly solved. Six months might be spent in getting the cargo aboard the great square-rigged ships. But this was as nothing to the length of the voyage to China and return—under sail across the Atlantic, around the Cape of Good Hope, through the Indian Ocean and past Singapore to Canton.

The commercial interests of Providence had their beginnings in the 17th century, and in 1711 shipbuilding began. But in those days before the Revolution the ships of Providence were busied chiefly in a great triangular trade in which, it has been said, one-fourth of the signers of the Declaration of Independence were bred, but which we now consider a shameful business for a free country. A ship taking lumber to the West Indies would bring back sugar and molasses to be distilled into rum. The rum would be shipped to the west coast of Africa and there traded for slaves, which in turn were sold in the West Indies or the Southern states to buy more sugar and molasses. Rhode Island merchants were thus the greatest slave-traders in America. Samuel Hopkins said in 1770 that there were 150 ships engaged in the slave trade, 30 distilleries making rum, and that his fellow colonists had "enslaved more Africans than any other colony in New England."

A Fine Harbor for Small Ships

For the old-time sailing ships Providence, although situated 35 miles from the open sea, at the head of Narragansett Bay, was a perfect harbor; but for the great steel steamships of today its approaches are too The last of the old-time Indiamen of shallow. Providence disappeared with the growth of steam navigation and manufactures about 1841, and since then Providence has declined as a port. But it still ranks high in bulk of tonnage and value of cargoes. Coastwise steamers bring coal from New York, Norfolk, Newport News, and Baltimore for Rhode Island's teeming factories, and one transatlantic line to the Mediterranean has found docks at the new state Something of the skill which built the old clipper ships still survives in the shipyards at nearby Bristol, where numerous "greyhounds of the sea" have been built to defend the famous America's Cup, first won from Great Britain by the racing yacht America in 1851.

Present-day Providence, like the whole of Rhode Island (of which it is the capital), is chiefly interested in manufactures. It is the second largest city of New England, and ranks first in the country for the manufacture of jewelry and silverware. It is also an important city for cotton goods, woolen goods, engines and boilers; it has the largest fine tools factory in the world, and is the second largest oil-distributing port on the Atlantic coast.

Relics of Former Days

Providence preserves a number of its old landmarks. Roger Williams Park, a beautiful 432-acre municipal reservation, is a part of the original tract ceded by the Indians to Roger Williams, who founded Providence in 1636. The meeting house of the First Baptist Church dates back to 1775 and the Friends' Meeting House to 1759. There are a number of old houses, and some of the street names are interesting as pointing to Quaker influences and to Providence's early commercial importance (Pound Street, Shilling Street, Dollar Street, etc.).

Brown University, chartered in 1764, is one of eight American colleges founded before the Revolution. The John Carter Brown Library, gift of a descendant of the original Nicholas Brown, is probably the most important collection of early Americana in the world, especially of books printed before 1800; and many of its small battered volumes cost nearly their weight in gold. Population (1940 census), 253,504.

PRUNES. Certain varieties of plums, called prunes, have such firm flesh and such a high sugar content that they can be dried with small loss of their original plumpness and flavor. This special quality has made prunes commercially the most important of all

30 to the pound; smaller ones run as many as 90 or 100. Next, the prunes are processed—that is, treated with hot water or steam to sterilize their skins of all contaminating material. Finally, the prunes are packed for shipment in wooden boxes containing 5, 10, or 25 pounds or in cardboard cartons of 1 or 2 pounds. The choicest ones are packed like dates.

The prune is one of the most nutritious of foods. It is a source of vitamins A, B, and G (see Vitamins), and is rich in iron, calcium, and phosphorus. Its pulp is used as a food for infants. Children and adults find prunes delicious in ice cream, bread, jams, and pies. Prune juice is enjoyed as a beverage, and granulated

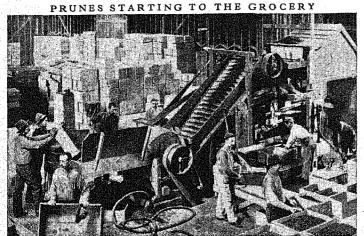
prunes are used as breakfast food.

The most important varieties of prunes grown in California are the French Petite or Prune d'Agen, the Robe de Sergeant, the Imperial, and the Sugar prune. In Oregon, the Italian prune is most generally cultivated. It is larger and more tart than the French prune and has been found highly suitable for canning in the fresh state. Prune trees do not usually come into profitable bearing until they are six years old, and not into full bearing until from 12 to 15.

PRUSSIA, GERMANY. The ruins of the old castle of Hohenzollern, from which the former ruling family of Prussia takes its name, may still be seen as the center of a little narrow strip of Prussian territory in the far southwest of Germany, near the headwaters of the Danube River. But what a contrast there is between those days of early weakness and Prussia's military might at the beginning of the World War!

Three factors produced the power of the Prussian kingdom—the able and unscrupulous Hohenzollern dynasty; the "mark" (border territory) of Brandenburg, with Berlin as its capital; and the duchy of Prussia, lying beyond the Vistula River in lands conquered in the 13th century by the crusading order of Teutonic Knights from a heathen people akin to the Slavs (Borussians), and made a secular duchy at the time of the Reformation (1525) under a collateral branch of the Hohenzollerns.

The first great forward stride of the main line of the family was made in 1415, when Frederick of Hohenzollern used the wealth which he gained as "burggraf" of Nuremberg to buy from the Emperor Sigismund the rule over Brandenburg. Its possession made the Hohenzollern prince one of the "seven electors" of the Holy Roman Empire. But Brandenburg, lying in the northern plain between the Elbe and the Oder rivers, was a poor flat country, with barren sand hills heaped up by the inclement winds. Gradually its Hohenzollern margraves (German markgrafen, "border counts") increased their territory-northward at the expense of Pomerania and Mecklenburg and southward at the cost of the Saxon marks. In 1609 the acquisition of some small isolated territories on the middle Rhine gave them a footing in western Germany.



By means of machinery, which handles them very rapidly, prunes are boxed while they are still hot from a sterilizing bath of hot water or steam. After cooling, the prunes are ready for shipment to the world's markets.

plums (see Plum). In California, Oregon, and Washington, which produce nearly all the prune crop of the world, the prune industry measures its income in millions of dollars annually and its production of fruit in many millions of pounds. California alone produces in some years as much as 75 per cent of the world's total crop. Europe's prune industry is centered in Yugoslavia and France, where dried prunes have been used as food for hundreds of years.

From tree to dinner table, there are many chapters in the story of prunes. First, they are gathered from the ground after they have become so ripe that they have dropped off the trees. The prunes selected for drying are washed in hot water or in a weak lye solution to remove "bloom" and dirt from the skins. Next, they are placed in wire-bottomed trays and are dried either in the sun or in dehydrators (see Dehydrated Food). Sun-drying takes from 10 days to two weeks: dehydration, only from 20 to 36 hours. Underdried prunes ("chocolates") are removed, and the satisfactory ones are placed in bins two or three weeks or longer to soften the skins hardened by drying. Then the prunes are sacked and taken to packing plants. Here they are inspected and then graded for size on shaking gratings, the smaller prunes sifting through the holes in the gratings. Larger prunes range from 20 or The third important factor was added in 1618, when the duchy of Prussia fell by inheritance to the margrave of Brandenburg. It was the task of "the Great Elector," Frederick William (1640–1688), and of his successors to round out, consolidate, and strengthen

But when Prussia measured arms with Napoleon on the field of Jena, in 1806, her armies were crushed. The reorganization carried on by Baron Stein and others enabled Prussia to take her part in the final overthrow of Napoleon in 1813–15, and as a result

her territories lost to the French were restored and enlarged. A "zollverein" or customs-union helped to pave the way for political unity of the German states under Prussian headship. As a result of revolutionary movements of 1848-49 the Prussian king granted a constitution for his kingdom, in which however there were comparatively few democratic features.

Bismarck's unscrupulous diplomacy in provoking war with Denmark in 1864, with Austria in 1866, and with France in 1870, brought Prussia increased territory and the coveted German headship. Schleswig-Holstein, the kingdom of Hanover, Nassau, Hesse-Cassel, and Frankfort-on-the-Main were all absorbed into Prussia; and the Prussian king was proclaimed emperor as William I (1871-1888) of the new German Empire. Thenceforth the history of Prussia is merged in that of

atest of the German states, minions steadily grew until population of all Germany.

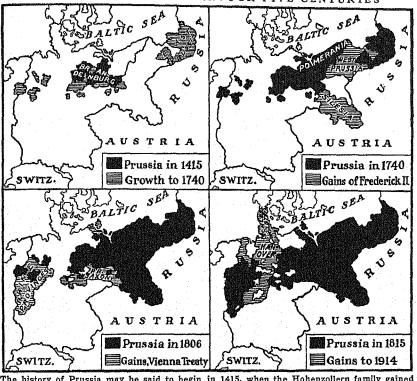
The neeforth the history of Prussia is merged in that of Germany. (See Germany.)

It is not surprising that Prussia practically controlled the new German Empire. It included two-thirds of the area and three-fourths of the population, and its king was the emperor of all Germany.

The revolution and the peace treaty after the World War left Prussia still the mightiest state of Germany. A republican form of government was set up in 1918. In 1933, however, the National Socialists placed Prussia under the absolute rule of a governor. Prussia absorbed the state of Waldeck in 1929, and in 1937 was given the state of Lübeck and portions of the states of Hamburg and Oldenburg. Prussian areas were given to Hamburg and Oldenburg in return.

The chief industrial regions of Germany lie in Prussia, including more than 20 cities of over 100,000 population. Among these are Berlin—the capital not only of Prussia, but of all Germany—Cologne, Essen, and Frankfort-on-the-Main. (See separate articles on these cities.) Important seaports are Königsberg, Stettin, Lübeck, Emden, Cuxhaven, and Kiel. The area of Prussia after Memel was annexed in 1939 was 114,527 square miles; population, 41,915,000.

PRUSSIA'S GROWTH THROUGH FIVE CENTURIES



The history of Prussia may be said to begin in 1415, when the Hohenzollern family gained possession of the little electorate of Brandenburg. For two centuries there was no indication that this poor flat country was destined to be the nucleus of the greatest of the German states, but after the Hohenzollerns acquired East Prussia in 1618, their dominions steadily grew until they included two-thirds of the territory and three-fourths of the population of all Germany.

these scattered possessions into a strong military state. Long wars with the Slavs and the absence of defensible frontiers had already given a military stamp to the Brandenburg-Prussian power. The Great Elector's son, Frederick I, won the title "king in (of) Prussia" in 1701. His son, the rough father of Frederick the Great, is chiefly remembered because of his fostering care of the Prussian army, and for the regiment of giants that he recruited from all over Europe—by gift, purchase, and even kidnaping.

What could be done by the unscrupulous use of this Prussian military power was shown by Frederick the Great (Frederick II) in his long reign from 1740 to 1786. The territory of Prussia was almost doubled by the conquest of Silesia from the young and beautiful Maria Theresa of Austria, and by the annexation—through the first partition of Poland—of West Prussia, which separated the Duchy of Prussia from Brandenburg. Incidentally Frederick helped to confirm in Prussia that belief in aggressive war as its "national industry" which lay at the root of Germany's part in the World War of 1914.



The WONDERFUL SCIENCE of the MIND

PSYCHOLOGY. Have you ever watched the construction of a building? First detailed plans must be made, then the site must be excavated, the foundation built, and so on through many operations. If it is a large building many different workmen must come in and take up the work where other men have left off.

Think of the amount of understanding and cooperation necessary for any such work that requires the efforts of many persons! Where men work together they must have similar ideas so that they can understand one another, and they must have harmonious modes of conduct so they can cooperate, or work efficiently together.

A parent must know how his child thinks and feels if he is to direct its conduct. A teacher must know what ideas pupils already have if he is to be able to teach them more complicated ideas. Similarly an employer must understand his workmen, an officer his soldiers, and the judge must understand the prisoner who is on trial.

When men collect facts about the behavior of human beings, organize these facts, and study their relations in a systematic way, they are studying "psychology" (from the Greek psyche, meaning "mind," and logos, "science"). The word psychology, therefore, means the science of the mind; but the science of psychology, as it has actually developed, includes not only the processes we ordinarily think of as mental, but the behavior of the organism as a whole. Of course, not all who have this interest are psychologists. It is only when they systematically gather facts concerning the mind and try to formulate the laws which govern such facts, that they become scientific students of psychology.

Facts with Which Psychology Deals

Some of the important facts and laws of psychology have been known for many centuries, but it is only in the last half-century that most of our information has been discovered.

First of the facts with which psychology deals is the matter of sensation and perception, or what we receive through the senses. The ancient Greeks thought there were just five senses—sight, touch, taste, smell, and hearing, but modern laboratory investigations have shown that there are many more. (See Sensation and Perception.)

But there is more to our mental life than receiving impressions. Ideas "follow each other through our thinking," and psychology attempts to discover and state the laws which govern this stream of experience or the association of ideas. Aristotle long ago stated certain of these laws, and every psychologist since has striven to understand and explain them. But we not only associate our experiences; we recall them and recognize that they belong in some way to our past—that is, we "remember" them. The subject of memory, therefore, constitutes one of the large chapters in psychology (see Memory).

This study of sensation, of perception, of association, and of memory, leads to an inquiry as to how people meet new situations, solve problems, and reason out better ways of doing things. Thus we have chapters on imagination, thinking, judgment, and reasoning (see Imagination). The person who does these things successfully we call intelligent, and thus we study intelligence.

We all know that our sensations, memories, and judgments are often accompanied by feelings which, when they are pronounced, we call fear, anger, joy, and so on. Psychology, therefore, also studies the *emotions*. In recent years, much has been learned about the emotions and their contributions to personality. (See Emotions.)

The Problem of Learning

In all psychological discussions, the problem of learning looms large. We acquire new methods of meeting situations and build up a wide range of skills or habits (see Habit). But even before learning, there exist in the human being tendencies to react which have been described as reflexes and instincts (see Reflexes). Upon the basis of these inherited modes of response, the learned behavior of the individual is built up. (See Learning.) The topic of learning is of particular importance to the teacher, since he spends his life in bringing about modifications in the behavior of his pupils through learning. It also underlies every field of psychology we consider, since the human being is always acquiring and building up new modes of action. Most inherited and many learned acts are automatic or involuntary, others are deliberately chosen. This leads to a discussion of will (see Will).

In addition to being interested in the ways in which people react and feel and think, psychology is concerned with the differences between individuals. It has developed many methods of measuring differences and is increasingly able to estimate a person's assets and deficiencies. (See Individual Differences.) Much attention has also been given to the inheritance of mental traits and to determining the extent to which environment modifies or changes an individual's original equipment (see Heredity).

Another important field is the adjustment of the individual to his life situation. This has resulted in intensive study of personality and character, and has given rise to many practical efforts to increase the well-being and happiness of children and adults. (See Character and Personality; Mental Hygiene.)

Psychologists are also concerned with the conditions under which human beings work and the study of the factors which bring about maximum efficiency and the minimum of harmful effects. Analyses of this sort are of special importance in the field of industrial psychology. (See Work and Fatigue.)

By psychology, therefore, we mean the study of the manner in which human beings sense and perceive, learn and remember, imagine and reason, feel and act, together with the differences between human beings, their mental development, and the conditions under which they function.

The Fields of Psychology

Like other sciences, psychology splits into a number of special fields. These depend partly upon the predominant interests and partly upon the use to which knowledge of the subject is to be put. The parent field is experimental psychology, for it was only with the study of human beings under controlled conditions in the laboratory that the modern science was divorced from the armchair speculations that preceded it. In university and college laboratories experimental research is being carried on in scores of different lines.

The study of the relations between mental processes and the changes which take place in the body, particularly in the brain and nervous system, is known as physiological psychology and has contributed much to

both psychology and physiology.

A particularly active field is that of developmental or genetic psychology, also called child psychology. Workers have been tracing the course of mental development from infancy to adult life and have found much that is of value to the teacher, the parent, and all who have to do with children (see Child Development). They are interested, too, in the other end of the developmental picture, and are studying senility or the decline of men-

tal functioning in old age.

Through studies of the behavior of animals, much has been discovered both about the stimuli which lead to animal action and about the actions which result. The field of animal psychology enlists many capable workers. The older anecdotal knowledge of animal behavior is being replaced with a new and accurate knowledge obtained under controlled conditions. Animal psychology not only gives us new methods of research for our human problems, but also throws much light on human behavior. For instance, the studies on learning in animals have given many new points of view from which to approach human learning.

There is also the field of social psychology which gathers together all the facts which are peculiar to human beings when they live in groups. Social psychology is exceedingly important to commerce and industry, to education, to politics, and to religion, and to the proper understanding of international affairs. In the latter field, a particular form of social psychology known as racial psychology is of value to enable nations to understand one another.

Its Use to the Teacher

The expression applied psychology is frequently used to designate one or all of the special efforts to use psychological knowledge in connection with medicine, education, business, industry, and the law. Applied psychology is the general term, whereas educational psychology, for instance, indicates a more limited portion of the field.

Psychology has been found useful in education, for

what has been learned about memory, thinking, instinct, learning, and intelligence, effectively aids teachers in their methods of work. Wherever teachers are trained, they study educational psychology, just as doctors study anatomy and physiology.

Psychology in Medicine

Psychology has important relations to medicine. This is particularly true of abnormal psychology, which involves the study of deranged mental conditions. The companion field in medicine is known as psychiatry, which is concerned with the treatment of insane and abnormal persons. Unstable emotional conditions such as fear, anger, and love sometimes produce distorted complexes of ideas that make an individual behave "queerly." The great emotional strain of the war produced many mental aberrations in soldiers. In recent years the field of abnormal psychology has attracted much interest, very largely because of the psychoanalytic movement (described later in this article). The field of abnormal psychology is also of much interest to those engaged in the law, or those who have contact with defective, abnormal, criminal, or anti-social individuals.

Psychology and Industry

With the development of modern industry and machines, it is natural that some interest should be shown in the men who operate the machines. Hence we have the active field of industrial psychology. One important branch of this field is concerned with the selection of personnel, choosing the right man for the job, and the right job for the man. Many industries now have personnel workers who select employees. There are also many experts in the field of vocational psychology who seek to discover methods of assessing the capabilities of the young man or woman in such a way that they may be guided into a vocation in which they will be both happy and efficient (see Vocational Guidance). Various tests and techniques have been designed for the use of personnel and vocational guidance workers. Studies are also being made of the reason for accidents in industry, of the best distribution of work and rest periods, of reactions to various signals, and similar problems. The field of business psychology parallels the field of industrial psychology. It seeks to do in the office and other commercial establishments what is being done in machine shop and production plant. Perhaps the most highly developed aspect of business psychology is to be found in the field of advertising. This is natural, since advertising is, above all, an attempt to stimulate human beings to react in a certain way. (See Advertising.)

Recent Developments in Psychology

It may be said that the real study of psychology has hardly begun. There is an infinite mass of information still to be acquired, and the increasing complexity of modern life is forcing a rapid extension of psychological study.

In modern psychology there has been a marked reaction against identifying mind with consciousness, and describing the human being solely in terms of what he knows, feels, senses, and thinks. The most marked evidence of this tendency is to be found in behaviorism, a psychological method which seeks to describe the human wholly in terms of what he does. Behaviorism, instead of classifying mental states such as sensation, perception, reasoning, and so on, divides human behavior into inherited pattern reactions and acquired pattern reactions, and describes how these reactions originate and are developed within the life of the individual. The emphasis upon experiment, observation, recording, rather than upon introspection—the description of one's own feelings and mental states—has resulted in obtaining much new material on human behavior. Important contributions have been made in the study of animals and children.

The "Gestalt" Movement

A more recent reaction against traditional psychology is to be found in the Gestalt movement, an approach to psychology which developed in Germany. The Gestalt psychologists are opposed to the tendency of the traditional psychologists to divide the mind up into its elements, thus missing the wholeness or Gestalt quality of our experience. To illustrate: In the conventional analysis of the perception of movement, movement was divided into the stimuli occurring at various points, whereas movement actually is perceived as a whole rather than as a bundle of separate sensations. When we look at a moving picture we do not see the thousands of separate pictures of which the film is composed but rather see persons moving about before us on the screen. In like manner most of our experiences are experiences of wholes, or "Gestalts." It is only by analysis that we become aware of the parts of which they are composed. The Gestalt psychology also emphasizes the relativity of our experiences. The headlights of my automobile seem very bright when nothing is before me; they seem very dim when a car with bright lights is coming toward me. The quality of a perception or sensation depends partly on its own stimulus value, partly upon the context or ground upon which it appears. In the field of animal psychology, the Gestalt psychologists have emphasized "insight" as characteristic of learning, rather than the "trial and error" of the behaviorists. By insight they mean a sudden shaping up of a response to a situation, rather than a gradual elimination of the unsuccessful features of the response.

What Psychoanalysis Is

Another movement which has sharply affected modern psychology is psychoanalysis. Although this was originally a mode of treatment for hysterical cases under medical supervision, it has opened the way to many new problems and interests. Psychoanalysis traces present mental difficulties back into the earlier life of the individual and finds their explanation in repressed wishes, emotional conflicts, and the interaction of "complexes." It emphasizes sexual desires as underlying motivating forces. Usually the underlying cause is buried in the unconscious mind and can only be brought back into awareness by an elaborate

technique. In the practical working out of this technique, dreams, slips of the tongue, reveries, free associations, and the like are used to bring back the buried memories. This comparatively new method has enriched psychology and has contributed much to our modern point of view.

The fourth great movement which has affected modern psychology springs from a series of tests given many years ago by Alfred Binet to normal and retarded children in Paris. The intelligence test is so much a part of our current phraseology that we do not realize how recent is its development (see Intelligence Tests). From it have come a mass of investigations that have led psychologists on and on in their studies of human behavior. The problem of the retarded and deficient child was first thrown into clear relief, and practical measures for educational and institutional treatment followed upon the scientific studies (see Mental Deficiency). Then the "gifted," or superior, child was studied with resulting increase in knowledge and practise. Paralleling these developments was the appearance of a wide variety of measuring techniques called achievement tests which could be applied to all aspects of school work and which gave new insight into the normal child as well as the retarded or the gifted. Recently interesting attempts have been made to measure personality and character by devices patterned after intelligence tests.

Great Names in Modern Psychology

In modern psychology some of the best-known contributors are William James (1842–1910) of Harvard, Wilhelm Wundt (1832–1920) of Leipzig, and Alfred Binet (1857–1911) of Paris. James is best known by two volumes entitled 'Principles of Psychology' published in 1890 which "defined the boundaries of a new science (psychology) with unapproachable genius." Wundt's great contribution to psychology was the development of the experimental study of mental life and of the laboratory method. Binet was the originator of the scale for the measurement of intelligence.

To these names must be added that of Francis Galton (1822-1911), a genius who made contributions to many sciences, and who worked out the statistical and quantitative methods which play so prominent a part in modern studies. G. Stanley Hall (1846-1924) both personally and through his students laid the foundations for genetic psychology and was a leader in the child study movement. Sigmund Freud (1856-1939), a Viennese physician, was the foremost figure in the psychoanalytic movement. Edward L. Thorndike (born 1874) after opening out the new field of animal psychology, stimulated much of the modern development in educational psychology. E. B. Titchener (1867-1927), a student of Wundt, was the leader of the introspectionists until his death; John B. Watson (born 1878) is the chief advocate of behaviorism; and Max Wertheimer (born 1880) is considered the founder of the Gestalt school, although its chief exponent is Wolfgang Köhler (born 1887).

REFERENCE-OUTLINE for Organized Study of PSYCHOLOGY—

 $W^{
m HEN}$ men collect facts about the behavior of human beings in a systematic way and study their relations, the resulting science is called "psychology." Although psychology is sometimes defined as "the science of the mind," and sometimes as "the science of human behavior," there is no disagreement on the importance of the subject and its practical value. One of its newest and most promising fields is Child Psychology-the study of the child's mind and its development. The discoveries in this new field of investigation are fundamental to modern scientific procedure in the guidance and training of children. One of its revolutionary conceptions is that parents determine the way in which the child's mind will grow and develop, just as they determine how its body will grow and develop. Hence it is just as important for parents to understand the principles of Child Psychology as to understand the principles of health and nutrition. These principles are also fundamental to educational procedure (see the Reference-Outline for Education).

- I. NATURE AND SCOPE OF PSYCHOLOGY:
- A. Definition: P-360. Mind M-181.
- B. History and Some Outstanding Leaders: P-362.
- II. NERVOUS SYSTEM AND BRAIN: N-64-5, B-219-24.
- III. SENSE ORGANS OR RECEPTORS:
- A. Types of Sense Organs: S-76.
- The Eye: Stimulation-Light L-125-31; Structure and Function E-349; Sensations S-76-8-Color C-308a.
- The Ear: Stimulation—Air Vibrations S-76; Structure and Function E-126; Sensations-Sound S-194-8, S-76.
- D. Other Sense Organs: S-76. Touch T-116: Taste-Tongue T-16, T-107; Smell S-164.
- IV. EFFECTORS OR MUSCLE AND GLAND CELLS: Muscles M-304; Vocal Muscles V-330; Glands G-99.
- V. SENSATION AND PERCEPTION: S-76-8. False Perceptions or Illusions I-19.
- VI. INHERITED MODES OF BEHAVIOR: Heredity H-283-6; Reflexes R-63; Instincts P-360, A-202-3, E-162; Emotions E-262; Involuntary Behavior W-98; Motor Development C-198-9.
- VII. EMOTION AND PERSONALITY: Emotion E-262; Character and Personality C-140; Mental Hygiene M-118; Personality and Character Development C-201.
- VIII. LEARNING, OR THE MODIFICATION OF BEHA-VIOR: L-79-82. Conditioning R-64; Education E-162-3; Habit H-193; Practical Implications, Study S-309-10; Reading R-56.
- IX. INTELLECTUAL PROCESSES: Memory M-113; Imagination I-20; Intelligence I-96-7; Language Development in the Child C-199; Development of Interests and Activities C-201; Dreaming S-163.
- DIFFERENCES: I-71-3. Heredity X. INDIVIDUAL H-283-6; Intelligence Tests and Mental Tests I-96-7; Character and Personality C-140-1; Mental Deficiency M-117-8. Mental Hygiene M-118; Sensory Defects-Blindness B-156-7; Deafness D-22; Child Development C-197-202.
- XI. DEVELOPMENT OF THE HUMAN BEING: Heredity H-283-6; Embryology E-258-9, B-114-5; from Infant to Adult C-197-202, A-21.
- XII. FIELDS AND APPLICATIONS OF PSYCHOLOGY: P-361. Animal Psychology P-361, A-202-3; Educational Psychology P-361, E-184; Abnormal Psychology P-361; Hypnotism H-377; Emotion E-262; Mental Deficiency M-117; Mental Hygiene M-118; Industrial Psychology P-361; Advertising A-23; Work and Fatigue W-147; Vocational Guidance V-317.

- XIII. CHILD PSYCHOLOGY: One of the most fruitful recent developments is the study of Child Psychology. Some of the topics which this study emphasizes are:
- A. Physical Development: C-197-8, T-28-30, A-21-2.
- B. Motor Development: C-198-9. Reflexes R-63-4.
- C. Language Development: C-199-200.
- D. Intellectual Development: C-200-201. Intelligence and Achievement Tests I-96-7.
- E. Personality and Character Development: C-201-2, C-140-1. Character Education C-141-3; Emotions E-262; Mental Hygiene M-118; Adolescence A-21-2.
- F. Development of Interests and Activities: C-201-2. Play and Games P-247-58; Kindergartens and Nursery Schools K-17-21.
- G. Learning: L-79-82. How Reflexes Are Conditioned R-64: Habit H-193; Memory M-113; Study S-309-10.
- H. Individual Differences: I-71-3. Heredity H-283-6: Intelligence and Mental Tests I-96-7; Mental Deficiency M-117-8; Sensory Defects B-156-7, D-22.
- I. Practical Applications in Education: E-162-4. Kindergartens and Nursery Schools K-17-21.
- XIV. MODERN MOVEMENTS IN PSYCHOLOGY: Behaviorism P-362; Gestalt Psychology P-362; Psychoanalysis P-362, E-262; The Mental Test Movement P-362, I-71-3, I-96-7; Mental Hygiene, M-118.

Bibliography for Psychology

General and Social Psychology

Britt, S. H. The Social Psychology of Modern Life (Farrar, 1941). James, William. Psychology; Briefer Course (Holt, 1923). Judd, C. H. Psychology of Social Institutions (Macmillan, 1936). Overstreet, H. A. About Ourselves (Norton, 1927). Roberts, W. H. Psychology You Can Use (Harcourt, 1943).

Thorndike, E. L. Human Nature and the Social Order (Macmillan,

Tiffin, Joseph. Industrial Psychology (Prentice-Hall, 1942). Woodworth, R. S. Psychology (Holt, 1940). Wright, Milton. Getting Along with People (McGraw, 1935).

Psychology of Childhood and Adolescence Adams, G. K. Your Child Is Normal (Covici, 1934).

Adler, Alfred. Education of Children (Greenberg, 1930).

Anderson, J. E. Happy Childhood (Appleton-Century, 1933).

Arlitt, A. H. Child from One to Twelve (McGraw, 1931). Blatz, W. E. and Bott, Helen. Management of Young Children (Morrow, 1930).

Cole, Luella. Psychology of Adolescence (Farrar, 1942). Faegre, M. L. and Anderson, J. E. Child Care and Training (Univ. of Minnesota Press, 1930).

Gesell, A. L. and others. The First Five Years of Life (Harper, 1940). Groves, E. R. and G. H. Wholesome Childhood (Houghton, 1931). Hollingworth, L. S. Gifted Children (Macmillan, 1926).

Hollingworth, L. S. Psychology of the Adolescent (Appleton-Century, 1928). Jersild, A. T. Child Psychology (Prentice-Hall, 1940). Kawin, Ethel. Wise Choice of Toys (Univ. of Chicago Press, 1934).

Kirkpatrick, E. A. Fundamentals of Child Study (Macmillan, 1929). Murchison, C. A., ed. Handbook of Child Psychology (Clark Univ. Press, 1933

Stoddard, G. D. and Wellman, B. L. Child Psychology (Macmillan,

Strang, Ruth. An Introduction to Child Study (Macmillan, 1938). Thom, D. A. Everyday Problems of the Everyday Child (Appleton-Century, 1927).

Educational Psychology

Bode, B. H. How We Learn (Heath, 1940).

Dewey, John. How We Think (Heath, 1933). Freeman, F. N. Mental Tests; Their History, Principles and Applications (Houghton, 1939).

Hollingworth, H. L. Educational Psychology (Appleton-Century,

Judd, C. H. Psychology of Secondary Education (Ginn, 1927). Ragedale, C. E. Modern Psychologies and Education (Macmillan, 1932).

Skinner, C. E. Educational Psychology (Prentice-Hall, 1936).

PTOLEMY (töl'ĕ-mǐ). Among the most trusted generals who accompanied Alexander the Great on his conquests in Asia was a Macedonian named Ptolemy, who became one of the seven bodyguards attached to that king's person. After Alexander's death (323 B.c.), Ptolemy received Egypt in the division of the spoils of empire, and ruled it for 38 years. He was the founder of a line of Greek rulers in that country, of whom the last was Ptolemy XIV, or Caesarion (47-30 B.C.), supposed son of Caesar and joint ruler with his mother, Cleopatra. He and his mother met violent deaths in 30 B.c. Egypt became a Roman province, and the Ptolemaic rule ended.

About 170 years later, new distinction was conferred upon the name Ptolemy by the famous astronomer, geographer, and mathematician, Claudius Ptolemaeus. Whether he was related to the royal house of Egypt is uncertain. All we know of him is that he was a native of Egypt and lived in Alexandria, and probably died soon after 161 A.D.

Ptolemy was a compiler rather than an original thinker or investigator, but he did his work so well that his books remained the standard textbooks down to the close of the Middle Ages.

In astronomy his great work was the 'Almagest', as Arab scholars called it, from the Arabic words meaning "the greatest." This contained the first treatise on trigonometry, which Ptolemy developed for the use of astronomers. Ptolemy explained all the motions of the heavenly bodies on the theory that they all revolve around the earth: and this theory held sway until Copernicus showed its error.

Ptolemy's 'Guide to Geography' was chiefly a set of maps and a list of places with calculations of their latitude and longitude. These calculations were based on an underestimate of the size of the earth and so contained serious errors, but his maps were not improved on for more than 12 centuries.

PUBLIC UTILITIES. When we want gas, electric light, or telephone service, usually we cannot choose among different companies, as we can in buying most other things. There will be just one company of each kind in our community. That company is obliged to serve us, provided we observe its rules and pay its charges; and its services and charges are regulated by the government. Such a company is a public utility, or public service industry.

Social Control Necessary

Public utilities differ from other business enterprises in having a special public interest. The services they provide are more or less indispensable to the community. They usually need special grants of privilege to operate, such as the right to use the public streets or lay gas mains. They usually have a monopoly or a close approach to monopoly of their functions. For these and other reasons they are regulated by the government.

Until the time of the Civil War, the only common public utilities were ferries, bridges, canals, and toll roads. To induce men to build them the government let the builders charge tolls, and gave them a mononolv of the business. On the other hand, the government insisted on the right to regulate them to insure good service and fair rates.

When inventors gave us gas, electric light and power, the telephone, and street cars, it seemed at first that competition between different companies would insure good service and low rates. But it was soon found that there could be little competition in public utility businesses. One reason is the expensive equipment each company needs. Two telephone companies, for example, might have to spend a million dollars apiece for equipment in a city, whereas one company could serve the city with equipment costing only 1½ millions. Besides, it is inconvenient for the public to have two telephone systems in the same community. So most public utilities naturally tend to become monopolies, because the public is better and more economically served when there is only one large company for each kind of service.

Local utilities, such as water, light, telephone, and street-car companies, were at first regulated by the communities through charters or grants of franchises. Services affecting a larger area, such as railroads, were regulated by state legislatures through provisions in their charters.

As these businesses grew in importance and power, this machinery of regulation proved inadequate; and early in the 20th century all the states except Delaware set up state public service commissions to deal with all classes of utilities. Utilities which operate outside the limits of a single state are regulated by federal agencies such as the Interstate Commerce Commission, the United States Maritime Commission, the Federal Power Commission, and the Federal Communications Commission.

The state commissions usually have control over rates, service, and accounting. Some also have authority over new issues of securities. The commission can order changes in rates or service if it believes them to be warranted. If the public service company believes that the commission's order will prevent it from earning a fair return on its capital, it can appeal to the federal courts to set the order aside.

Public and Private Ownership

The public utility problem is so complicated that many think it can best be solved by having city, state, and national governments own the utilities and run them at cost. Others argue that governments rarely run anything as efficiently as private managers; and they hold that where lower rates are given, this is because the government-owned utility does not have to pay taxes. They also point out that government-owned utilities are always liable to misuse by officials in power for political purposes.

The greatest publicly owned utility in the United States is the Postoffice. Of major importance are the huge federal irrigation projects in the West. Most cities now own their water services, and many own

gas, electric light, and street-car services.

A Pueblo Indian drilling a

turquoise.

In Canada and the European countries public ownership is more common, and railroads, telephone and telegraph services, and other public utilities are government operated to a considerable extent.

PUEBLO (pwā'blo) INDIANS. In the arid regions of New Mexico and Arizona there still live tribes of semi-civilized agricultural Indians -Hopi, Zuñi, Taos, etc.-who in the early days were named "Pueblo" Indians by the Spaniards from their habit of dwelling in stone or mud-brick "cities." The name pueblo, applied to these "cities," comes from the Spanish word meaning "village" or "people." There are 28 pueblos which are still inhabited, in addition to hundreds of ruined structures which formerly were populous centers. Among the most interesting are the now deserted habitations of the former "cliff dwellers," who were among the ancestors of the present tribes. (See Cliff Dwellers.)

The typical pueblo was often built for defensive purposes, on the top of a lofty flat-topped hill,

called a mesa. It is a many-roomed structure, of two to seven stories piled one upon another, like a series of terraces, so that the roof of one building is the "front yard" of the next above. The upper houses are reached by means of ladders. Slabs of sandstone laid in adobe mortar are used as building material, but most of the modern villages are built of sundried bricks.

The present-day Pueblo Indians are industrious farmers and skilful potters. Some are basket-makers and weavers, like their ancestors. Except for nine Hopi villages in Arizona, they all live in New Mexico. They are nominally Christian, though they still retain many of the primitive rites and customs, and their ceremonial dances attract many tourists each year. Number of Pueblo Indians, about 15,000.

PULAS'KI, CASIMIR (1748–1779). Among the soldiers of Europe who aided the Americans in their struggle for independence was Count Pulaski, a Polish nobleman. In his own country Pulaski had taken an active part in the struggle to keep Poland free from Russian domination. The struggle had been unsuccessful, and Pulaski had been exiled in 1772. He had escaped to Paris, where he eventually met Benjamin Franklin, the American representative. Franklin persuaded Pulaski to aid the colonies in their struggle for freedom, and in 1777 Pulaski joined the American army.

He immediately distinguished himself at the battle of Brandywine, and for his bravery was commissioned a brigadier general. He served for some time under Washington, and then was given permission to raise an independent corps which became known as "the Pulaski Legion." At the head of this force he successfully defended Charleston from an attack by the British in May 1779, but in an unsuccessful attack on Savannah, Ga., in October of the same year, he

fell mortally wounded, and died two days later. Though he had been unable to preserve liberty in his own country, he had helped to win it for the new nation in the Western Hemisphere.

PULSE. The phenomenon known as pulsation (Latin pulsus, "a pushing" or "beating") is due to the distention of the arteries when blood is sent into them by the contraction of the heart. The pulse is usually examined at the radial artery at the wrist, the advantage of that position being that the artery is near the surface and easily compressed against the bone. The veins have, normally, no perceptible pulse.

The pulse itself is unimportant. It might be called a by-product of the fact that the heart beats rhythmically and the arteries are elastic. However, by study-

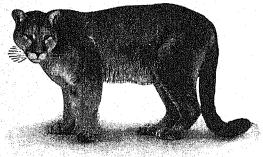
ing the pulse the physician can learn something of the condition of the heart, blood-pressure, and blood-vessels; and these are very important things for him to know about.

The frequency of the pulse (which means, of course, the frequency of the heart-beat) varies with age, from 130 or 140 per minute in infancy to 70 or 75 in adult age. It also varies with sex, adult females having six or eight more beats per minute than males. It is increased by exertion or excitement, and is diminished by lying down or sleeping. In some diseases the pulse may reach 150 to 200 beats per minute; and, on the other hand, in certain organic affections of the heart, it may be as slow as 25 or 30. (See Blood: Heart.)

PUMA. Occasionally when forest rangers in the Rocky Mountains are riding back through the darkness to their lonely cabins, they are startled by a blood-curdling scream like the cry of a woman in mortal terror. It is the voice of the puma or mountain lion. Few persons, however, have heard the puma's cry, for it is the quietest of the cat family, and usually hunts silently, flitting like a shadow on the trail of a deer, or springing without a sound upon a strayed calf, colt, or sheep.

Next to the jaguar of South America, the puma is the largest of all American cats. Formerly it ranged from ocean to ocean, and from Canada to Patagonia. The early pioneers called it "panther" or "painter" and dreaded it as a fierce and treacherous beast. In the United States they have now disappeared from all but the wildest portions of the West. Though the puma is a bloodthirsty killer of sheep and other small domestic animals, it becomes tame and docile in captivity. Puma kittens at birth are

A POWERFUL BUT COWARDLY BRUTE



The Puma has a fierce glaring eye and muscles like steel, but it is so slinking and cowardly that few have been known to attack human beings.

covered with spots and stripes, but these soon disappear to make way for the uniform reddish-brown color of the parents. When full grown, pumas measure about 40 inches from the nose to the root of the tail, which adds another 25 inches or so to the length. Other names for the puma are American lion, catamount (also applied to the lynx), and cougar. Its scientific name is Felis concolor.

PUMP. Each of us has one of the most marvelous pumps known—a beating heart—working away inside of us, day and night as long as we live. What is a pump? It is a machine for moving fluids, ordinarily for lifting liquids. Among the earliest and simplest devices made by men for the purpose were probably the well-sweep and the bucket raised by a rope over a windlass. The Persian wheel or noria—a wheel placed upright with the lower portion of the rim submerged in the water, and with buckets so hung all around the rim that each in turn, as the wheel revolves, dips up water and then pours it out on a higher level—is another primitive device. It has been improved into the chain-pump, in which the buckets are carried on an endless chain traversing two wheels, one down in the water and another on an upper level.

A much later invention is the suction pump, by which water is first pushed up through a tube by air pressure or suction (see Air), and then lifted by the bucket or plunger. From the pump-head down into the water runs an air tight tube. The pump-head is provided with a spout and a handle which by means of a plunger-rod works a plunger up and down in the tube. This plunger fits the tube closely; on its upper surface it carries a valve hinged to open upward. Fixed in the lower end of the tube is another similar valve.

When the handle is raised, pushing the plunger down, the pressure of the confined air opens the plunger valve but holds the lower or inlet valve shut. When the handle is forced down, raising the plunger and increasing the space between the two valves, a partial vacuum is created, and the pressure of the rarefied air within no longer balances the pressure of the air without. The weight of the outer air pushes the plunger valve shut and raises the water in the pump, opening the inlet valve. So by successive strokes the water is raised until it stands above the plunger, and is lifted to pour out at the spout.

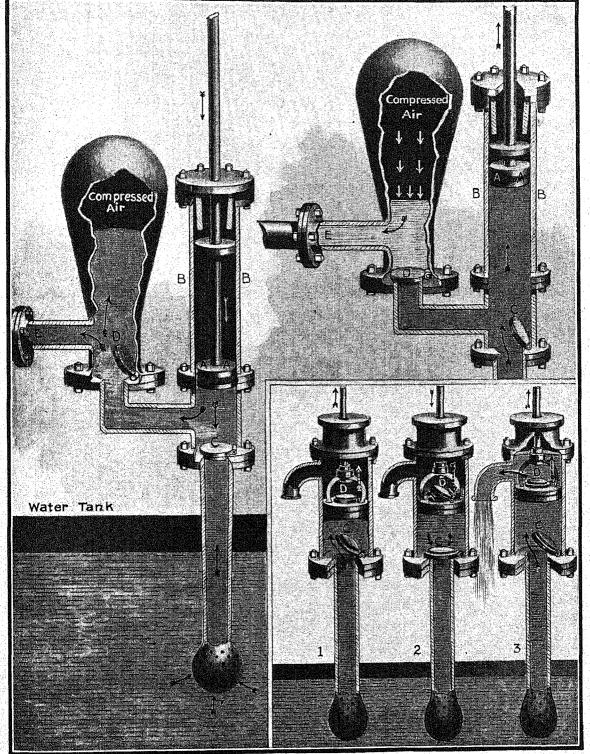
It is atmospheric pressure alone that raises the water until it passes the plunger valve. For this reason the suction-pump can raise a column of water only to a point at which the weight of the column is equal to the pressure of the atmosphere. This, at sea level, is about 32 feet; and because all pumps leak more or less the practical limit is about 25 feet. If water must be raised to a higher level, some other form of pump must be used. The simplest of these is the force-pump, which may be simply a suctionpump provided with a delivery pipe and a third valve, instead of a spout. Since the water above the plunger is lifted, not pushed up by the air, it may be lifted to any height by the addition of the third valve to prevent back-flow. An air cushion is commonly added to equalize the flow of water. When the plunger is lifting water, the air is compressed; when the plunger descends, the compressed air expands and presses the water up through the delivery pipe, thus securing a steady stream of water.

These pumps are wonderful inventions; but innumerable varieties of far more complicated pumps are now in use. There are many varieties of the forceand suction-pumps; many kinds of impeller pumps, including centrifugal pumps, aspirators, and injectors; impulse pumps or hydraulic rams (see Hydraulic Machinery); and many kinds of power pumps.

PUMPKIN. Pumpkin pie takes equal rank with turkey as a part of Thanksgiving dinner, for since the days of the earliest settlers, who found the Indians cultivating this big squashlike fruit in their fields of maize, the pumpkin has been a favorite article of food. The pumpkin vine grows to a length of 20 feet or more, and has large leaves, hollow prickly stems, and large yellow flowers. In America pumpkins are still planted as the Indians planted them, between the rows of corn. The fruit weighs usually between 10 and 40 pounds, but often attains a much larger size. Pumpkins turn from green to yellow as they ripen, and are ready to harvest only when other vegetation has been killed by the frost. Raw pumpkins are used for cattle food and to make "Jack-o'-lanterns" for Hallowe'en; they are also canned so as to give us pumpkin pie all the year round. In pioneer days they were sliced and hung in strings from cabin roofs to dry for winter use. James Whitcomb Riley has well celebrated the beauty of the days "when the frost is on the pumpkin and the fodder's in the shock." (See also Squash.)

PUNCTUATION. A misplaced comma once cost the United States government \$2,000,000. In a tariff bill about 50 years ago the section enumerating what

TWO WAYS IN WHICH PUMPS RAISE WATER



The large left-hand drawing shows the downward stroke of the piston (A) in the barrel (B) of a force pump. Intake valve (C) is closed, and water is passing through the outlet valve (D) to the discharge pipe (E), and into the air chamber. In the upper right-hand picture an upward stroke is drawing water through the intake valve (C). The outlet valve (D) is closed and the air compressed in the air chamber by the last "down" stroke is maintaining the flow. In the pictures below the rising piston of a suction pump (1) the air chamber by the last "down" stroke is maintaining the flow. In the pictures below the rising piston of a suction pump (1) is drawing water through intake valve (C). On the downward stroke (2) this valve shuts, and the piston valve (D) admits water to the cylinder. The next upward stroke (3) discharges this water and draws up more.

articles should be admitted free of duty specified "all foreign fruit-plants," etc., meaning plants for transplanting, propagation, or experiment; but a clerk in copying the bill changed the hyphen in the compound word "fruit-plants" to a comma, making it read, "All foreign fruit, plants," etc. The consequence was that for a year, until Congress could remedy the blunder, all oranges, lemons, bananas, grapes, and other foreign fruits were admitted free of duty.

Many a lawsuit has turned on the question of punctuation. One such occurred in France, where the disposal of \$40,000 depended on the decision as to whether a small spot of ink was or was not a comma. For a less serious example, you know the nursery rhyme which reads, unpunctuated:

Every lady in the land Has twenty nails on each hand Five and twenty on hands and feet This is true without deceit.

Now read the same properly punctuated:

Every lady in the land
Has twenty nails; on each hand
Five, and twenty on hands and feet;
This is true without deceit.

Another instance of the difference made by merely interchanging two marks of punctuation is the story of a member of a legislative body who had called one of his fellow members a liar, and was compelled publicly to apologize for the offense. He did so by rising in his place and saying: "I said he was a liar, it is true; and I am sorry for it." The apology was deemed sufficient; but in the newspaper next day the apology was printed thus: "I said he was a liar; it is true, and I am sorry for it."

The ancient Greeks and Romans did not have to bother about punctuation; in very early times they did not even separate the words in writing. But if you attempt to read one of their ancient manuscripts, you will realize how much easier it is to read a page that is properly punctuated.

Manutius, a Venetian printer of the 16th century, is generally regarded as the father of our present system of punctuation. Its principal marks are the following: the period (.), generally placed at the end of a sentence and at the end of abbreviated words; the comma (,), used to separate words, phrases, and sometimes clauses: the semicolon (:), used to separate clauses or divisions of a sentence requiring a more marked separation than is indicated by the comma: the colon (:), used where the sentences require a more marked separation than is indicated by the semicolon. as well as to introduce a series of particulars or a long quotation; the dash (-), generally used to indicate a break in the thought or a change in the structure of a sentence; the interrogation point (?), used to denote a question; the exclamation point (!), used to express surprise; the hyphen (-), used between the divisions of a compound word and to divide any word at the end of a line; the apostrophe ('), used as a sign of the possessive case and to supply the place of any letter

or letters omitted from a word; the parentheses (), used to inclose explanatory matter; the brackets [], used to include the words or remarks of an author within the quoted writing of some other person; the double quotation marks (""), used to inclose any word or words quoted from another person; single quotation marks (""), used to inclose a quotation within a quotation and sometimes (as in this work) to indicate the title of a book, play, etc.

There are numerous rules for the use of these various points, but perhaps no two writers or printers would agree as to the proper mark to be used in all cases. Good judgment and taste, and a certain amount of practice, are essential to anyone who would punctuate in such a manner as to secure the fundamental object of punctuation—the correct expression of the sense. When in doubt about punctuation, ask yourself this question, "Is a comma or other point needed to make the meaning perfectly clear?" Remember that there is always a reason for every mark of punctuation.

PUPA $(p\bar{u}'p\dot{a})$. This is the third of the four stages through which an insect usually goes during its lifetime, the first two being the egg and the larva stages. At the close of the larva stage the insect fastens itself firmly to some object and generally builds a cocoon or case about itself, made of silk or some other substance produced by little glands in its own body. In this cocoon it sleeps, either entirely motionless, as though dead, or squirming a little only when disturbed. During this sleep great changes go on within the body of the pupa, so that when it comes out it is quite a different-looking creature from what it was when it began its pupal sleep. It has now become a full-grown insect, and usually has wings. This wonderful change in form can be best seen when a caterpillar goes into its cocoon, transforms, and comes out a pretty moth. The pupal stages of different insects are often called by different names. That of the butterfly is called the chrysalis. Only those insects which have what is called complete metamorphosis pass through the pupa stage. (See also Insects: Larva.)

PUPIN (pū-pēn'), MICHAEL IDVORSKY (1858-1935). A crowd of newsboys on New York City's Broadway was laughing and jeering at a 15-year-old lad who had just come from Serbia. They were amused at his queer clothes and the red fez on his head. Suddenly a boy knocked off the fez. The immigrant lad jumped at the bully, wrestled him to the ground, and got his fez back.

The boy who fought so well was Michael Idvorsky Pupin, and this was the first of many victories he won in his new home against staggering odds. His courage and intelligence finally carried him to high honors as physicist, inventor, teacher, and author. Among his inventions was the method of tuning used in every radio receiving set.

Pupin was born Oct. 4, 1858, in the Serbian village of Idvor, which is now in Yugoslavia. His peasant parents encouraged him to study in the local schools and later at Prague. At 15 he set out for the United States, where he could enjoy the freedom denied his people under the oppressive rule of Austria-Hungary.

When Michael landed, he did farm work and odd jobs, and later worked in a cracker factory. In his spare hours he studied at Cooper Union and elsewhere. In 1879 he entered Columbia College, where he earned his way by tutoring, giving instruction in wrestling, and other work. The day before his graduation in 1883, he took out final naturalization papers.

Having decided to make physics his lifework, he went to Cambridge University later that year to study mathematical physics. When Columbia awarded him its first John Tyndall fellowship in 1885, Pupin was enabled to attend the University of Berlin to work under the great physicist Hermann von Helmholtz.

In 1889 he returned to Columbia University and taught physical sciences there until he retired in 1929.

His teaching helped inspire several pupils to become famous men of science, notably Edwin H. Armstrong, inventor of the regenerative radio circuit; and Robert A. Millikan and Irving Langmuir, who later won Nobel prizes. In 1892 he invented his radio tuning device. His most important invention was the loading coil (often called the Pupin coil), which made longdistance telephony possible. It brought him a fortune. He is also credited with making the first X-ray photograph in America and with the discovery of secondary X-ray radiation. Several universities gave him honorary degrees. Success in a foreign land did not lessen his devotion to his own people, and he gave freely to help Serbians in both Europe and America. He died in New York City, Mar. 12, 1935. His bestknown book is his autobiography, 'From Immigrant to Inventor' (1923). Others are 'The New Reformation' (1927) and 'Romance of the Machine' (1930).

BEHIND the SCENES with the DOLL ACTORS



A charming scene from Sue Hastings' marionette production of the Cinderella story. If you look closely, you can see some of the strings by which the marionettes are made to gesture and move over the tiny stage with every appearance of life.

Puppers and marionetres. As long ago as a thousand years before the birth of Christ, puppers were as popular as picture shows are today. Once upon a time, the story runs, a Chinese emperor named Muh called in a famous pupper showman to entertain him and his many wives. The showman, Yen Sze, puffed up at being invited to exhibit at the royal palace, went happily to work and made a wonderful set of puppers that could open their lips, move their hands, and roll their eyes at the audience.

But when Yen Sze put on his performance at court, the puppets seemed so real as they flirted with the imperial ladies that the Emperor flew into a jealous rage. He ordered Yen Sze's head chopped off on the spot. The miserable showman begged for his life. The Emperor declared stubbornly that Yen Sze had to die. It was only when the showman tore his puppets into shreds that the Emperor realized that he had been made jealous by mere scraps of colored paper and strings. Then the Emperor relented and gave the

showman his life. Not all puppets are as convincing as Yen Sze's, but they have had a long and exciting career as actors in almost every part of the world.

The name puppet comes from a Latin word meaning "baby" or "doll." "Marionette," some authorities say, comes from an Italian word meaning "clown" or "fool." Others think it may have come from "mariolette," the name for a little image of the Virgin Mary.

It is not known certainly where puppets originated.

Some think it was in India. At least they were beloved there hundreds of years before civilization reached Europe. The Hindus of that faroff time believed that puppets had lived with the gods before coming down to earth, and accordingly they treated them with love and reverence. They carved lifelike images of pure gold, which they dressed in rich silks and gems. Legend says that they even trained starlings to speak the words of the plays, and imprisoned them in little cages in the puppets' throats to carry on the dialogue.

Ancient Egypt had

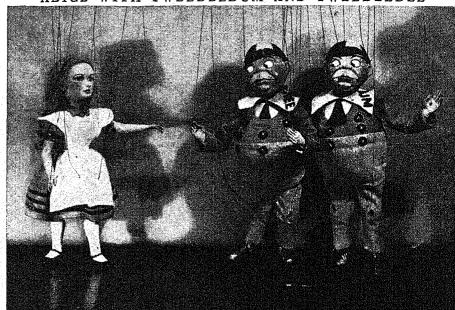
its puppets, too—little movable figurines of gold which women carried in sacred processions. Today explorers, in opening the tombs of Egyptian children, sometimes unearth clay puppets that may have been loved by the playmates of Moses.

In Greece puppet showmen jogged along the roads to entertain the populations of Sparta, Thebes, and Athens. When the Romans conquered Greece, they carried some of the puppeteers to Italy, where they became tremendously popular. From Italy, puppet troupers trudged the muddy trails of Europe in the Middle Ages, carrying their little actors to the fairs of what are now France, Germany, and England. In France the favorite character, as famous as Mickey Mouse today, was known as Guignol. In Germany it was Hans Wurst or Kasperl who delighted the audiences. In Holland it was Jan Pickel-Herringe, and in England Mr. Punch, with his hook nose and hunchback.

In England puppets were used first, however, to tell Bible stories in the churches. At Christmas time the little theaters would show the rising of the Star of Bethlehem, the journey of the Three Wise Men, and the Nativity. At Easter they enacted the Crucifixion and the Resurrection. At another season churchgoers could see St. George hack the head from the scaly Dragon. When the English Parliament closed the regular theaters in 1642, at the beginning of the Civil War, the puppet shows had their heyday. They fell heir to the wealth of plays that had been barred from the stage, and some of the former actors began speaking lines under the direction of puppet masters.

Among the many famous men who have delighted

ALICE WITH TWEEDLEDUM AND TWEEDLEDEE



"If you think we're alive, you ought to speak." An episode from Sue Hastings' 'Alice in Wonderland'.

This closeup shows clearly how the strings are attached to the little actors.

in puppet shows is the great German poet Goethe. who owned a toy theater when he was a child. One day he saw a puppet production of the old legend of Dr. Faustus, and from it took the theme of his greatest play. Shakespeare is said to have written 'A Midsummer Night's Dream' and 'Julius Caesar' with puppets in mind. Ben Jonson and Joseph Addison loved puppet spectacles and often mention them. Franz Joseph Haydn composed some charming music for marionettes. Oliver Goldsmith, so Boswell says, almost broke a leg one time trying to prove he could jump over a broomstick as gracefully as a puppet. In 1674 Paris could boast a puppet opera company, and Munich has long had a little theater built in a park expressly for puppet actors. It is called "Papa Schmidt's Theatre," for a famous puppet showman, and has a stock of a thousand puppet actors.

In modern times, Maurice Maeterlinck, the Belgian playwright, began writing plays for puppets. The Viennese writer Arthur Schnitzler is another who seized on the possibilities of puppet performers. Gordon Craig, one of the most influential figures in the modern theater, has said that marionettes can express the thoughts of writers much better than can actors

of flesh and blood. These are among the men who were responsible for the awakening of a new interest in puppets in the United States, though there had been puppet plays in America long before. The Indians used marionettes in religious ceremonies centuries ago. Beginning in 1739, we have many tattered playbills to show that there were puppet performances of David and Goliath, the Burning of Rome, and Jack and the Wonderful Beanstalk, in America as well as in Europe.

But perhaps the Puritans did not approve of the wooden actors, for puppetry never really gained a foothold in the United States until 1915, when Ellen Van Volkenburgh and Maurice Browne staged a puppet performance in Chicago. Four years later, Tony Sarg sent out his first company, and in 1923 the Sue Hastings marionettes gave their first performance. From that time on, puppets have flourished.

Puppets are used not only for entertainment, but for educational purposes as well. In Russia for years the straggling puppet showman has been a familiar figure, with his hand organ, his monkey or bird, and his folding screen that housed a handful of bedraggled puppets. Now he has a fresh set of actors that are being used to teach political ideas to people who still have difficulty with the printed page. In many schools in the United States, puppet troupes help in the teaching of the social sciences, languages, handicrafts, and hygiene, as well as literature and dramatics.

Puppets have had a great deal of success in motion pictures, notably in the film 'I Am Suzanne' and in the Russian version of 'Gulliver's Travels'. They have been used successfully in stage revues and musical comedies. One of the interesting recent uses of puppets is in television broadcasts. They make

excellent material for television drama because of their miniature size and the comparatively low production costs.

Three Kinds of Puppets

Puppets have been made of many different kinds of material—clay, wood, metal, cloth, leather, straw, and paper—and they are worked by all sorts of devices. They fall in general into three classes.

Guignol or hand puppets are made to slip over the hand, with a finger thrust into the head and one into each of the puppet's arms. For a play with only two characters, this type is ideal. Punch and Judy were almost always worked on the operator's hands.

Another type is the rod puppet, which is worked by a rod thrust up through the body, and other rods to control the various parts. The Javanese are especially skilled in the use of rod puppets. They are so fond of their beautifully dressed performers that they sometimes sit up all night to watch a play. Richard Teschner, a famous designer of exquisite puppets in Vienna, controls his strange, lovely figures with rods. For years there was a company of rod puppets in New York City. When 'Orlando Furioso' was presented, with about 400 puppets weighing nearly a hundred pounds apiece, the little actors fought so gallantly that the floor boards of their stage had to be renewed every two weeks. They performed for two hours or more every night and the complete cycle lasted 13 months!

The most common type of puppet in the United States at present is the one that is controlled by strings. This is usually called a marionette, to distinguish it from the hand puppet. The number of strings may vary from three to thirty, depending on what the operator expects his puppet to be able to do.

How to Make Puppets and Use Them in Plays

PROBABLY the easiest way to make a puppet is to take a rubber ball about two inches in diameter. Paint a face on one side and cut a hole in the bottom just big enough for the forefinger to slip through. Cut a hole in the center of a big handkerchief to serve as a costume. Fit the handkerchief over the hand, put your finger into the ball, and you have a puppet ready to perform. A darning egg may be used in the same way. Thrust the handle of the egg through the hole in the handkerchief and grasp it from below.

For string puppets, dolls and toy animals of soft cloth can be used. If ready-made dolls are used, however, part of the stuffing must be taken out to make them limber. Hollow out the stomach and stitch it across so that the puppet can move freely at the waist and sit down. Sew the arms and legs back on loosely. Stitch the elbow, ankle, and knee joints across twice about a quarter of an inch apart. Treat the neck in the same way. Weight the feet with shot or small pebbles so that the figure will stay down on the floor.

If you plan to make an entirely new puppet, then first draw a pattern on paper, in five pieces—for the

trunk of the body, and for neck, arm, leg, and head. Allow a quarter of an inch on all sides for seams. Pin the paper parts together, and when you have adjusted them to look like the figure you have in mind, cut each piece on a fold of cloth. Seam, turn, and stuff each piece hard with cheap cotton, and weight the feet. Sew the arms and legs to the body, leaving the joints loose. The neck should not be stuffed, or the head will not nod or turn. Before sewing on the head, add crêpe hair, or hair made of string or darning cotton. The features can be drawn with crayon or sewed with embroidery floss. Dress the puppet before adding the strings. Attach strings to each hand, each knee, and each side of the head just above or behind the ears. Another string from the lower end of the spine will make the puppet bow.

Since you cannot hold all the strings without getting them tangled, you will need a "control." A simple type of control consists of three strips of wood about an inch wide, to which the strings are attached. To make it, you will need a pocketknife, tacks, wire, a few screws, and a strip of leather. The main control is

PUPPETS AND MARIONETTES NEW POPPED SOLAR

made by fastening two of the strips of wood together in the shape of a cross. Near the ends of the crossbar a leather strip is attached to make a handle through which the hand may be slipped. The free end of each string is attached to the control, as shown in the sketch below. Usually the string from the base of the spine is fastened to the lower end of the long arm of the cross (B) and the strings from the hands



B—C is the long arm of the main control, and A—A is the fixed crossbar. The crossbar F—F has a hole E in the center so that it can be slipped over the peg D.

go to the upper end (C). The strings from the head go to the tips of the crossbar (A—A).

The knee strings are attached to a second crossbar (F-F). This is held in the hand when the puppet is walking. When not in use, it is slipped over a peg (D) on the main control to leave both hands free for working other strings.

The simplest stage is a high-backed, solid chair, preferably one with wings. Pin your scenery to the back of the chair

and use the seat as a stage. The back will partially conceal you from your audience as you lean over it to operate the actors. When manipulating hand puppets, you can kneel in the seat of the chair and raise them into view over the back. Be careful not to let your wrists show below the costume.

Another simple puppet stage is made out of a clotheshorse with three sides. Turn the middle section toward the audience, and the two sides extending back at right angles will conceal you. Cover all but the upper front section with paper or cloth; wall-paper is good, as it is gay, inexpensive, and can easily be renewed. Make a curtain for the opening or use a window shade cut to the right size. The words of the play can be written out and tacked to the inside walls.

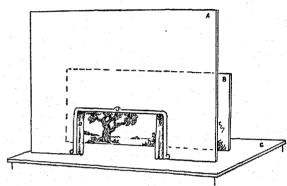
For a more elaborate marionette stage, use a discarded doll's house, or a large box of wood or heavy cardboard. Settings and backdrops can be made of cardboard or pieces of cloth. For indoor scenes, paint or sew on doors, windows, and fireplace. For outdoor scenes, paint or sew on trees, flowers, or whatever else you need. The fewer the "properties," or pieces of furniture, on your stage, the less likely your marionettes are to become tangled. Christmas-tree lights can be twisted into footlights.

Since marionettes must be worked from above, it is a good idea to rest the stage on a substantial table that you can stand on. It is also a help if you can place the table in a draped doorway, so that the curtains will hide you from your audience.

Another form of puppet show is the shadow play, which is especially popular in China, Siam, and Java. All it requires is a sheet or screen of semitransparent

material, a set of puppets cut from cardboard or cellophane mounted on cardboard, and a strong light. The light is placed behind the characters, which are worked from below by means of rods. The shadows are thrown on the screen while the showman speaks the lines.

Stretch the sheet across a door, blocking the lower part with furniture or heavier material. Behind it, set a desk lamp or floor lamp that has a strong bulb. Each piece of the puppets should be made separately. and the various pieces fastened together with brads. They are moved by stout wires attached to the different parts. The wires should be long enough to allow the puppeteer to keep his hands below the level of the transparent screen. Scenery can be cut out in miniature and placed immediately in front of the light, which will magnify it to the size of the screen. A



Cardboard is used for this simple stage setting. A is the front, or "masking," and B is the backdrop, on which scenery is painted or sewed. C is the top of the table and D is the curtain.

sharper effect will be obtained if the scenery is cut to measure and tacked just behind the screen.

Many plays have been written especially for marionettes. Samuel French, Inc., has a list of suggestions for puppet productions in its annual catalog. Paul McPharlin, editor of the Puppetry Bulletin, 150 Wimbledon Drive, Birmingham, Mich., is always glad to help young puppeteers with suggestions about choosing and staging plays. However, perhaps the most satisfactory puppet performances come when you write or dramatize your own productions. (For a list of books on puppets and marionettes, see Hobbies.)

PURE FOOD LAWS. Because health depends so largely on clean and nourishing food, governments have made laws since early times to prohibit the sale of adulterated foodstuffs and beverages. In the Middle Ages especially, many such regulations were imposed. In the United States the individual states took the lead in passing laws to prevent adulteration and to regulate the quality of food products. There was little national regulation, however, until Congress passed the Federal Food and Drug Act of 1906. This was replaced in 1938 by the Federal Food, Drug, and Cosmetic Act. The Federal government enforces the act through the Food and Drug Administration. Since it controls only interstate commerce, the states have similar regulations of their own.

Foods and beverages, for animals as well as for human beings, are subject to regulation under the Act of 1938. This law requires that labels tell if arti-

ficial coloring or flavoring or chemical preservatives have been added. The use of common food names, like "butter," is not permitted on packages containing substitutes. In fact, all deceptive or misleading labeling is forbidden. Strict watch is also kept to prevent the sale of meat from diseased animals, or of foods made from decayed fruits or vegetables or prepared under insanitary conditions.

Drugs must measure up to federal standards of purity and strength. New drugs must be tested and reported to the government before being put on sale. Habit-forming drugs must bear a warning label. Devices designed to correct physical ailments are also subject to rigid regulation. Harmful cosmetics are forbidden, and hair dye containing coal-tar color must carry a label warning against use near the eyes.

PURITANS. "I will make them conform or I will harry them out of the land." This was the threat that

The division began among the religious exiles from England who sought refuge on the Continent during the Catholic persecutions of Queen Mary's reign; and it became acute at Frankfort-on-the-Main in the quarrels between the "Knoxians" and "Coxians" (followers of John Knox and Dr. Richard Cox) over the wearing of priestly vestments. In general the Puritans inclined to follow the lead of Knox, Calvin, and the Swiss reformers, who would reject all usages of the Catholic church for which positive warrant was not found in the Scriptures, and would thus reduce the worship of their churches to the bare simplicity of Apostolic times. So arose their opposition to written prayers, religious images and pictures in the churches, instrumental music in the church services, and the like.

Some of the Puritans, instead of wanting merely to purify the church services, wanted to change the whole government of it as well. The Presbyterians, for

instance, wanted to do away, "root and branch," with the government of bishops in the church, but would retain a state church. Others. called Separatists, or Independents, wanted the church and state to be entirely separated and each congregation to manage its own affairs; these were later Congregationalists. called Still more radical reformers called Anabaptists (or Bapthought baptism tists) should be given only to adults, and held other startling views as to church and state.

It was a band of the Separatists who went first to Holland in 1608, and then to America in 1620, where

they founded Plymouth Colony (see 'Mayflower'). James I and Charles I carried out the threat to "harry the Puritans out of the land," and thousands of others came to America, especially during the "Great Migration" of 1629-40. When the Civil War between the king and Parliament gave the control of the government into the hands of the Puritans, the emigration for a time stopped (see Cromwell, Oliver).

At the Restoration in 1660 the Puritans lost control of England, but the seeds of civil liberty and of a more serious outlook on life which they planted bore fruit in after-years. Not only greater freedom in religion but also greater freedom in government are among the things which we inherit from these Puritans, along with the literary works of Milton and Bunyan.

Since 1689, when a Toleration Act was passed, the English dissenting bodies have had a legal status, and today virtually no religious tests remain, except in the case of the crown.





Going to church in New England in the early days wasn't a mere matter of getting up early enough on Sunday morning, for Indians might be lurking about anywhere. For years the settlers had to go in companies, as shown in this well-known painting by the American artist George H. Roughton.

King James I of England made to the Puritans when they asked him to "purify" the state church of England of certain ceremonies and usages derived from the Roman Catholic church, which they disliked. These Puritans were not dangerous sectaries, but were just plain citizens of England-farmers, merchants, professional men, and scholars, especially from the University of Cambridge. They came to be regarded as gloomy fanatics, and it was humorously said that "they objected to bear-baiting, not because of the pain to the bear, but because of the pleasure to the spectators." The Puritans of the time of James I, however, were not afraid of innocent pleasure. Many of them were fond of music; the Puritan country gentlemen hunted; and the writings of one of the foremost Puritans, John Milton, have come down to us as a priceless literary heritage.

The Puritans were the advanced wing of the Protestants in England in the days of the Reformation.

LITTLE TALKS ON GREAT THINGS by Arthur Mee

PURITY



AR back in the imagination of the world is the splendid figure of a man. He may never have lived; he may just be the child of another

man's mind, for the mind of a man can dream things that can never come true in the life of a man. Yet this figure stands like a central glory in the great Past of the world. He is the everlasting figure of Purity, of singleness of purpose, of high and noble aim. He comes to us in story and in poetry; his eyes look out on the world from great pictures. His name was Galahad.

Lord Tennyson has told us the great story of the search for one of the world's lost treas-The knights of King Arthur's court went out to search for the Holy Grail, the cup from which Jesus drank at the Last Supper on the night before the Crucifixion. Far beyond the evils of the world it lay, and sin could not come near it. Knight after knight came home without finding the Holy Grail; but at last one knight, whom no temptation turned aside, succeeded in the quest, It was Galahad—true, brave, and pure. He had gone out into the world with a single purpose; he had let nothing evil come into his life.

Be a Galahad. If you would find the cup that never fails, if you would have the peace that all desire, be a Galahad.

You may not ride through the world on a white horse to find the Holy Grail, but you may be a Galahad in the street, the factory, or the shop, at school or at home.

You are looking out into the world, as Galahad did; you have something to find, as Galahad had. Galahad succeeded where others failed, and his secret is ours. He sought the highest end by the noblest means. He gave his utmost for the best. He kept the great end in view. He set an ideal before him, and followed it with the devotion of a friend for a friend. Nothing small or mean could swerve him from his path. He put first things first; he did not sacrifice a great end for small considerations. Selfishness, the petty desire for praise, the fear of mockery—all these he left behind him.

And, whatever you do in the world, believe that there is no surer way to success than this. You may work so that all you do heaps up advantages for yourself, and leaves those who help you tired and joyless and poor. When you look back upon such a life, though you look back upon it in a palace, the looking back will bring you no peace. But you may work, instead, so that all you do heaps up advantage for yourself and others; and if you work like that, though you look back in a cottage, you will have a peace that nothing in the world can take away.

Set a great purpose before you. Follow it to the end. Let nothing mean or selfish or ignoble enter into your soul. Be brave, with the courage of David; be true, with the truth of King Alfred and George Washington; be pure, with the purity of the Maid of Orleans. Be a Galahad.

SIR GALAHAD

My good blade carves the casques of men, My tough lance thrusteth sure, My strength is as the strength of ten, Because my heart is pure. The shattering trumpet shrilleth high, The hard brands shiver on the steel, The splintered spear-shafts crack and fly, The horse and rider reel. They reel, they roll in clanging lists, And when the tide of combat stands, Perfume and flowers fall in showers,

A maiden knight—to me is given
Such hope, I know not fear;
I yearn to breathe the airs of heaven
That often meet me here.
I muse on joys that will not cease,
Pure spaces clothed in living beams,

That lightly rain from ladies' hands.

Pure lilies of eternal peace,
Whose odours haunt my dreams;
And, stricken by an angel's hand,
This mortal armour that I wear,
This weight and size, this heart and eyes,
Are touched, and turned to finest air.

The clouds are broken in the sky,
And thro' the mountain walls
A rolling organ-harmony
Swells up, and shakes and falls.
Then move the trees, the copses nod,
Wings flutter, voices hover clear;
"O just and faithful knight of God!
Ride on! the prize is near."
So pass I hostel, hall, and grange;
By bridge and ford, by park and pale,
All-armed I ride, whate'er betide,
Until I find the Holy Grail. —Tennyson

PUTNAM, ISRAEL (1718–1790). Israel Putnam of Connecticut stands as one of the most picturesque figures of the American War for Independence. He had early won a reputation for bravery by crawling into a wolf den and killing a wolf at close range. This reputation was heightened by his thrilling exploits in the French and Indian War. At one time he rescued a band of English soldiers from a numerically superior band of Indians; at another he escaped capture by the Indians by shooting some perilous rapids in a river; finally he was captured by the Indians and taken to Canada, where he was soon exchanged.

In the long period of disagreement between England and her colonies, Putnam's sympathies were entirely with the colonies. He served as chairman of the Connecticut committee of correspondence, and as such carried to Boston the contributions of the Connecticut patriots when the port of Boston was closed by Eng-

lish orders. When the news of the outbreak of hostilities at Lexington reached him, he left his plow in the furrow, and hurried to Boston. For his conspicuous services at the Battle of Bunker Hill. he was commissioned a major-general in the Continental army. His services after the battle of Bunker Hill, however, were more picturesque than notable for their practical value. He had much personal bravery but was not a great general, as was shown by his unsuccessful leadership of the American forces in

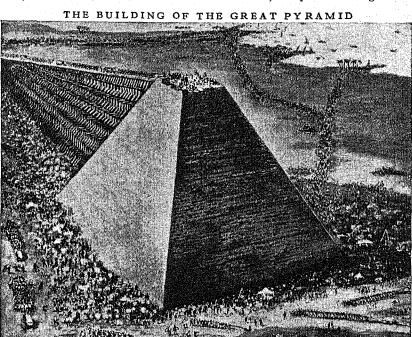
the highlands along the Hudson in 1777–78.

In 1779, two years before the close of the Revolution, General Putnam suffered a stroke of paralysis, and had to retire from the army. He lived to see the success of the cause to which he had given the best of his services, and died in the year following the

inauguration of Washington as president.

PUTTY. The cement that holds our window-panes in place and keeps air from leaking in around the edges of the glass is called putty. It is used also for filling holes or cracks in woodwork, and is occasionally colored and molded into relief ornaments. "Jeweler's putty" is used for polishing metals, glass, jewelry, etc. Putty is usually prepared by mixing a form of powdered chalk called "whiting" with linseed oil until a tough dough is formed. When dry it becomes very hard and sticks tightly even to smooth surfaces.

PYRAMIDS. For about 5,000 years the colossal tombs we call the Pyramids have reared their giant bulk from the hot sands of Middle Egypt, challenging the wonder and admiration of the generations. Built to protect the bodies of the Pharaohs until the Day of Resurrection, they have long since yielded up their secrets and the royal mummies have been plundered and scattered to the four winds of heaven. The polished granite and limestone slabs which once encased many of these monuments, concealing the entrance to the tomb chamber and making the sides impossible to scale, have been removed, but the ponderous interior structures, composed of rough-hewn

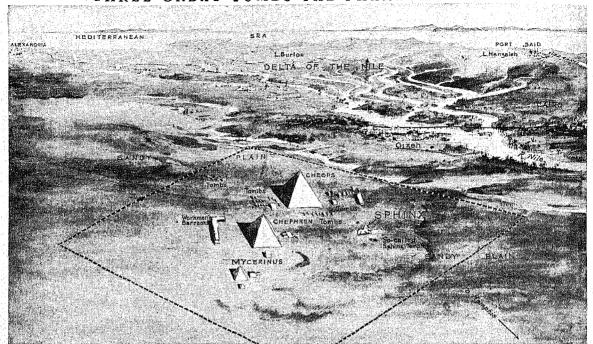


For twenty years the subjects of King Khufu in relays of 100,000 toiled under the taskmaster's lash, building the Great Pyramid as his monument. This large mass of brick and stone is the oldest of the ancient Seven Wonders of the World and, alone of them, survives. It is generally believed that the enormous stones were put in position by the aid of inclined planes, such as the artist has shown here.

blocks of stone or of brickwork, still stand as the greatest of all architectural achievements in point of massiveness. "Time mocks all things," says an Arab proverb, "but the Pyramids mock Time."

These royal tombs of ancient Egypt number about 50 or 60 of all sizes. The best examples are the three great pyramids of Gizeh, built by the early kings of the Pyramid Age, probably between 2900 and 2750 B.c. The first or Great Pyramid, erected by King Khufu (Cheops) is 725 feet square at the base and rises to a height of 481 feet. It is so large that if it were hollowed out, St. Peter's Church at Rome could stand inside of it and occupy only about half the ground space. Its stones are enough to build a wall around France. The second, the pyramid of Khafra, is but little smaller; while the third, the pyramid of Mycerinus, also called Menkaura, is about half as large.

GREAT TOMBS THE PHARAOHS BUILT



This bird's-eye view of lower Egypt looking down the Nile to the sea, shows the position of the Sphinx and the three pyramids of Cheops (Khufu), Chephren (Khafre), and Mycerinus on the wide and sandy plain across the river from Cairo. After Cheops had reigned his 50 years and his bones had been laid away in his great tomb, his brother, Chephren, who succeeded him, built the second pyramid; and then he died and was entombed. Next came Cheops' son Mycerinus, who crected the third and smallest of the series.

In the Great Pyramid the so-called king's chamber is located well up in the heart of the structure, connected with the outside by means of two air-channels and an entrance passage which leads downward from a point on the face of the pyramid about 47 feet above the foundations and then branches upward to the chamber by a concealed passageway. The main passageway continues downward, beyond the branching off of the passage to the royal chamber into the rock below the pyramid, where there is a chamber called the well. A third chamber is found in the heart of the pyramid, about halfway between the bottom and the king's chamber, connected with it; this is known as the queen's chamber. These halls and passages are all lined with polished granite and limestone, and show the marvelous ability and knowledge that the Egyptians possessed in contriving to support so great a weight of solid rock. (See also Architecture; Egypt.)

Extending like a jagged PYRENEES (pir'ë-nēz). and gigantic wall from the Bay of Biscay to the Mediterranean Sea, the Pyrenees form an almost unbroken mountain barrier between France and Spain. Bare, bleak, and rugged, the peaks reach a mean height of 5,000 to 6,000 feet, with many in the central portion towering to a height of 8,000 to 9,000 feet. Pic Néthou (Maladetta), the highest point in the range, is 11,168 feet high. On the hottest days of summer one sees on these peaks a crown of glittering snow and ice. From the lower tree and flower-clad

slopes branch out deep green valleys, through which wind beautiful streams fed from cascades that dash madly down from the rocky heights. There are now four trans-Pyreneean railway routes between France and Spain; from Hendaye (France) to Irun (Spain); from Cerbère (France) to Port-Bou (Spain), linking Marseilles and Barcelona; from Bedous (France) to Jaca (Spain); from Toulouse to Barcelona via Axles-Thermes (France) and Ripoll (Spain). passes in the Pyrenees permit wagon or automobile travel; still others are only mule trails. The boundary line of France and Spain follows along the central ridge. The tiny republic of Andorra, with an area of 191 square miles, lies in a deep valley in the heart of the eastern chain.

Fewer tourists are attracted to the Pyrenees than to many other regions less beautiful, for the roads are very difficult and walking and sightseeing trips, if not impossible, are most fatiguing. There are practically no game or wild animals, the eastern mountains having been ruthlessly stripped of their former heavy forests, and lax fishing laws have robbed the streams of a once plentiful supply of mountain trout.

The mineral ores of the Pyrenees are not in general of much importance, though some iron mining is done. Some coal deposits capable of being profitably worked are found on the Spanish side. The inhabitants of the region are chiefly occupied in farming and stock raising, plentiful pasturage for cattle, sheep, and goats being found in the upland meadows.

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PYROMETER (pī'rŏm'e-ter). If you visit a steel plant and ask questions you will hear a lot about temperatures. If your guide is an engineer he will probably be able to tell you exactly how hot is the glowing stream of metal when they pour it into molds and even how hot it is in the heart of a roaring blast furnace. How can he measure these temperatures? The ordinary thermometer would of course melt and vanish like wax under those conditions. What he actually uses is some form of pyrometer, which in Greek means "fire-measurer."

Pyrometers are required in scientific and industrial work when temperatures above 1,000° F. must be determined (see Thermometer). In modern technical practise the two electrical types tend to supersede all others. The first is the thermoelectric or thermocouple pyrometer. Two wires made of different metals are twisted around each other to form a long joint and then fused together to make a perfect contact. This joint is inserted in a protecting tube. The other ends of the wires are connected to a galvanometer. According to the thermocouple principle (see Electricity) we know that in a circuit made of two or more different metals if one junction is hotter than the others an electric current is generated. If then the fused joint inside its protecting tube is thrust into melted steel, say, or into a furnace, while the other connections in the circuit are kept cool, the degree of heat can be determined from the flow of current as indicated on the galvanometer. The latter is usually graduated specially for the purpose so that the temperature can be read directly. This kind of pyrometer may be of the "high-resistance" type in which the "couple" is made of fine wires, one platinum and the other platinum-rhodium alloy for the extremely high temperatures. For the lower ranges, various combinations of coarser "low-resistance" wires made of iron, nickel, and copper alloys may be used.

Next in inportance is the electrical-resistance pyrometer, usually consisting of a coil of platinum wire wound on a mica framework. The variation in resistance of the wire at different temperatures is measured with a Wheatstone bridge. This instrument can be used also for very low temperatures, such as that of liquid air (-312° F.).

Temperature can be determined at a distance by measuring the heat radiated from a hot surface. One type of radiation pyrometer simply uses a thermocouple or a combination of thermocouples called a "thermopile" for that purpose, but for many purposes an optical pyrometer is more convenient. The commonest form looks like a small telescope. It contains an electric lamp with a control for regulating its brightness. When this is adjusted so that the lamp and the glow from the hot surface are equally bright, the temperature can be read from a prepared scale.

Seger cones are narrow pyramids about two inches high made of various substances, each of which has a definite melting point. By exposing different cones to the heat in question, and noting the one which just barely melts, a reasonably close estimate of temperature can be made.

PYROXYLIN (pī-ròx'i-lin) PRODUCTS. Nearly everything has to have a finish, some kind of coating for protecting or beautifying the surface. Houses, trains, automobiles, ships, airplanes, floors and woodwork, linoleum, toys, and many other things that perhaps you can think of, have to be covered, usually with paint, varnish, or lacquer. A great deal of this kind of coating is made today from nitrated cotton or "pyroxylin."

When cotton, which is mostly cellulose, is treated with nitric acid, two things happen. It becomes soluble in alcohols or other suitable reagents, and if the nitration is carried far enough, it becomes explosive, as it is in guncotton (see Explosives). Pyroxylin for paints must not be explosive, so the nitration is carried only far enough to make it soluble. It is then dissolved in liquids that make it thin enough to spread and thick enough to cover, as a good paint must do. For a long time it was known that nitrocellulose products made good paint, but no cheap suitable solvent was available, until butyl alcohol, made by a micro-organism, in fermentation processes, was found to be such a solvent. With the use of butyl alcohol, butyl acetate, furfural, and other solvents, the manufacture of pyroxylin products has grown enormously. Brush or spray paints, varnishes, and lacquers are made by varying the nature of the solvent, and by adding pigments, or aluminum or bronze powders to color the clear colorless solution. The spray, applied in a fine mist of particles with air pressure, is used almost altogether for automobile and airplane finishes. These paints dry quickly, do not change after they are dry, and are very hard, durable, and resistant.

Besides paints, enormous quantities of plastics are made by combining pyroxylin with camphor. For this purpose, thousands of pounds of camphor come to America—natural tree camphor from Japan, synthetic camphor from other countries. Pyroxylin plastics far exceed other kinds; they include motion-picture film, substitutes for ivory, and many other products. (See Celluloid; Cellulose; Plastics.)

Rayon made by the Chardonnet process is a pyroxylin product (see Rayon). Artificial leather is made on a textile base and coated with pyroxylin; textiles are waterproofed with it, and unshatterable windshield glass contains a sheet of the material, bound with adhesive solution between two sheets of glass. Pyroxylin products will not burn so easily if acetates replace part of the nitrate in the making, an important point in making picture film and "airplane dope." Pyrrhus (přr'ŭs), King of Epirus (about 318–272 B.C.). Among the many rulers of petty kingdoms who sought to gain power after the death of Alexander the Great, one of the most celebrated was Pyrrhus, king of the mountainous little country of Epirus, to the northwest of ancient Greece. A brilliant and

dashing soldier, he was ambitious for glory and determined to found an empire in the West.

A quarrel had broken out between Rome and the Greek city of Tarentum in lower Italy. When the Tarentines applied for assistance, he gladly responded and crossed the Adriatic with about 25,000 troops and a number of war elephants. The forces met at Heraclea near the Tarentine coast and there a bloody battle was fought (280 B.C.). The Romans were terrified by the elephants, which they had never seen before, and Pyrrhus won the day. But his loss was so great that he is said to have exclaimed after the battle, "Another such victory and we are lost!" Thus arose the expression "Pyrrhic victory," which we still use of a victory so costly that it is little better than defeat. After another "Pyrrhic victory" at Asculum, he withdrew to Sicily.

Here, in aiding the Syracusans against the Carthaginians, he saw another opportunity for conquest. At first he met with brilliant success, but he soon lost popularity. He returned to Tarentum, where he met final defeat at the hands of the Romans in the battle of Beneventum (275 B.C.). Returning to Greece, Pyrrhus engaged in various military enterprises, but failed to realize his ambitions. He was almost on the point of gaining the Macedonian crown, which he so much desired, when, having been called to Argos to help settle a political quarrel, he was struck by a tile thrown from a roof and killed.

PYTHAGORAS (pt-tháḡ'ō-rás) (6th century B.C.). When this famous Greek philosopher heard a dog howl as it was beaten, he cried out: "It is the soul of a friend of mine, whom I recognize by his voice." This is the only remark of Pythagoras recorded by his contemporaries, and it shows his belief in the idea that at death the soul passes into another man, an animal, or even a plant. Many primitive people have held this belief in the "transmigration of the soul." It was taught by Buddha, and is still accepted by his followers.

After spending 30 years visiting the countries bordering on the Mediterranean Sea, he settled in Crotona, a Greek city of southern Italy, about 529 B.C.

There he founded a brotherhood, whose members were bound by vows of sobriety, self-control, and the observance of certain mystic rites. His order spread rapidly, but lost its popularity when it became involved in politics, and it was suppressed. Although the brotherhood was not revived, the teachings of Pythagoras continued to be widely accepted.

The Pythagoreans, as the followers of Pythagoras were called, made many important contributions to mathematics and astronomy. They discovered that "the square on the hypotenuse of a right triangle is equal to the sum of the squares on the other two sides" (see Geometry). They were the first to teach that the earth is a globe, revolving with other planets around a central sun. They also found that the length of a musical string is in exact relation to the pitch of its tone. Numbers fascinated the Pythagoreans to such an extent that they claimed that "all things are numbers," or that numbers were the substance of life. **PYTHON** (pī'thon). The tropical regions of Africa. Asia, and Australia are the haunts of the pythons, a group of usually huge and powerful serpents belonging to the same family as the boa. The reticulated python, a beautiful creature with a yellowish-brown body marked with iridescent black lozenge-shaped spots, reaches a length of as much as 30 feet, and is the largest snake found in the Old World.

Pythons are equally at home sliding through dense underbrush, climbing trees, or swimming. They kill their prey—chiefly birds, small deer, and other small mammals—not by poison-bearing fangs, but by coiling their muscular bodies about the victim and crushing it. There are few records of pythons attacking man.

The python grows slowly and probably lives to an old age. The female lays about 100 eggs, which she collects into a heap, then wraps herself about them until they hatch. During this strange incubation period she does not partake of food.

Besides the reticulated python (Python reticulatus), other well known species are the regal python (Python regius) of Africa, the Indian python (Python molurus), and the Australian diamond, or carpet, snake (Python spilotes).



THE EASY REFERENCE FACT-INDEX

GUIDE TO ALL VOLUMES FOR SUBJECTS BEGINNING WITH

TO SAVE TIME

USE THIS INDEX



EDITOR'S NOTE ON NEXT PAGE TELLS WHY

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EDITOR'S NOTE

First turning to the Fact-Index section at the end of each volume when in search of specific information. This index is a miniature work of reference in itself and will often give you directly the facts, dates, or definitions you seek. Even when you want full treatment of a subject, you will usually save time by finding in the index the exact page numbers for the desired material.

All page numbers are preceded by a letter of the alphabet, as A-23. The letter indicates the volume. If two or three page numbers are given for the topic you are seeking, the first indicates the more general and important treatment; the second and third point to additional information on other pages. Where necessary, subheadings follow the entry and tell you by guide words or phrases where the various aspects of the subject are treated.

The arrangement of subheadings is alphabetical, except in major historical and biographical entries. In these the chronological order is followed.

The pictures illustrating a specific subject as a rule appear on the same pages as the text to which you are referred. But often illustrations placed elsewhere will prove of additional interest and value. These are indicated by the word *picture* followed by a page number.

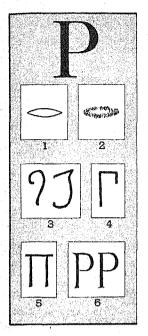
A picture reference is frequently intended to call attention to details in the text under the illustration as well as to the illustration itself. This picture-text, therefore, should always be carefully read.

The pronunciations given are those preferred by the best and most recent authorities; alternative pronunciations are indicated only where usage is equally divided. For foreign names the native pronunciation is given except where the English pronunciation has become thoroughly established, as in "Paris," "Barcelona," "Seine."

In recent years hundreds of foreign geographical names have been changed, either officially or by custom. Both old and new names are given at the appropriate places in the alphabet.

Populations are given in round numbers, except for places in the United States and Canada, where the figures are those of the latest official census. Distances between points are map or air distances, not distances by railroad.

THE EASY REFERENCE FACT-INDEX



Our LETTER P probably started in ancient Egypt as a sign for the mouth (1). Soon after 2000 B.C., a Semitic people called the Seirites adopted it as an alphabetic sign for the sound of 'p', because the Semitic name for 'the mouth' began with this sound.

The Seirite sign (2) was much like the Egyptian; but later the Canaanite-Phoenician alphabet used a curved line, frequently with an angle (3). In Hebrew the sign was called pe (pronounced 'pay'), and other Semitic languages had similar

The next change came when the Greeks learned to write from the Phoenicians. The Phoenician sign was shaped to suit the Semitic fashion of writing from right to left; but, when the Greeks came to write from left to right, they turned the letter around and gave the right-hand stroke a little tail (4) to distinguish the sign from an early gamma (see the Fact-Index article on G). The Chalcidian Greeks who settled in Italy also used a sign with curved upper strokes. Later the Greeks gave the sign more symmetry by lengthening the tail. The resulting 'classic' form (5), called pi, has remained unchanged in Greek ever since.

Before this happened, however, the Romans had learned to use the curved Chalcidian letter, and they closed the small curve into the upright stroke. This

created the Latin P (6), which passed into English without change.

Our handwritten small 'p' is a quickly made copy of the capital, and the printed small 'p' imitates the handwritten one.

Note.—For the story of how alphabetic writing began and developed, see the articles Alphabet; Writing.

-

William (1740-99). signer of Paca. Declaration of Independence; born Hartford Co., Md.; governor of Maryland (1782-86); U.S. district judge (1789-99).

Pace, ground dwelling rodent (Coclogenys paca); about 2 ft. long; fur varies in color from faun to black has longitudinal rows of lightcolored spots; lives in burrows along river banks or in old tree roots; strong, rapid swimmer; found from Ecuador to Brazil and Paraguay;

Formula (1988) Formula (1988) Formula (1988) Formula (1988), Russian pianist, noted for brilliant interpretations of Chopin's works; toured U.S.

(pa-kö'mi-üs), Pachomius (292?-346?), Egyptian monk; established first monastery: M-232

Pachuca (pů-cho/ků), Mexico, city 55 mi. n.e. of Mexico City; altitude 8000 ft.; pop. 41,000; cap. state of Hidalgo; silver mines, reduction plants: map M-133

Pachyderm (pāk'ā-dārm), a semi-scientific term applied to the ele-phant, the rhinoceros, the hippo-potamus, the tapir; from the Greek, meaning thick-skinned: E-248

Pachysandra (pak-t-sain'dra), a genus of creeping plants of the box family, native to N. America and Japan. Both evergreen and deciduous, with small flowers, white, greenish, or purple, in spikes; used as a ground cover in gardens; one species called mountain spurge.

Pacific, College of the, at Stockton, Calif.; institution of higher learning supported by Methodist church; founded 1851.

Pacific blockade B-157

Pacific bluestem wheat, picture W-82 Pacific Fur Company, organized by John Jacob Astor F-226

Pacific Highway, road connecting Vancouver, British Columbia, with Mexican border R-114

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Pacific Scandal, in Canadian history

Pacific silver fir. See Silver fir Pacific States, name used by U. S. government for geographic division including states of Washington, Oregon, California.

Pacific time T-94, diagram T-95, map U-198b

Pacific Union College, at Angwin, Calif.; founded 1909 by Seventh Day Adventist church; arts and sciences.

Pacific University, at Forest Grove, Ore.; Congregational; founded 1854; liberal arts, music.

Pacific yew Y-206

Pacius (pü'sē-us), Friedrich (1809-91), Finnish violinist and composer of popular songs, two operas and an operetta; composed music for 'Vart Land' (Our Land), Finland's national song.

ack, Charles Lathrop (1857–1937), banker and forester, born Lexing-ton, Mich.; studied forestry in Black Forest, Germany; aided in reforestations of Europe after 1st World War and established foundations to encourage progress in forestry; started Cleveland Trust Co.; wrote 'Forests and Mankind' and 'Forest Facts for Schools'.

Packard, Frank Lucius (1877–1942), Canadian novelist, born Montreal, Quebec, of American parents; works include 'Greater Love Hath No Man', 'The Miracle Man', and 'Jimmie Dale' mystery stories.

Pack artillery, in army A-307c Packing effect, in atoms C-169, A-345

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Pact of Paris, or Kellogg-Briand Pact (Treaty for the Renunciation of War, 1928) C-354, A-247 ineffectiveness of N-75b signing of, picture P-91

Pacto'lus River, ancient river in Lydia, the present Sarabah; gold found in its bed ascribed in mythology to bathing of Midas: C-399

Padang (pä-däng'), Sumatra, seaport in center of w. coast; pop. 50,000; large trade in coffee, tobacco, copra: maps E-142, A-332c

Pad'dington, metropolitan borough of w. London, England; pop. 145,000; formerly noted for picturesque rural scenery.

Paddlefish, a fish of the Mississippi River system, remarkable for its long spadelike snout with which it stirs up mud to get its food; sometimes reaches a length of 6 ft. or more; also called "spoon-billed cat-fish."

Paddle wheel steamers S-122, S-128, picture S-118

Paddy, term for unhusked or unmilled rice, whether growing or cut; name sometimes applied to the field in which rice is grown.

Padeloup, family of French bookbinders; best known are Antoine (died 1668), famous master binder (died 1668), famous master binder, and his grandson Antoine-Michel (born 1685), called the Younger; latter's work impeccable, body of binding solid yet supple, gilding in dentelle style, inlays in varicolored leathers twelfeld. leathers unrivaled.

i'aderewski (pä-dě-rěf'ski), Ignace Jan (1860–1941), Polish musician and statesman P-11

Paderewski Fund P-11

Padilla, (pä-dē'yā) Ezequiel (born 1890), Mexican lawyer and statesman, of Indian blood; revolutionist under Pancho Villa 1914-16; exile in New York City 5 years; as secretary of public education 1929-30 helped to build Mexico's modern school system; minister to Italy and Hungary; fo 1940: M-142f foreign minister from

Padilla (pā-dē'yā), Juan de (1500?—44?), Franciscan missionary, born Andalusia, Spain; came to Mexico about 1528; built monasteries at Tuxpan, Zapotlan, and Tulancingo; accompanied Coronado's avagatiton accompanied Coronado's expedition (1540) north to Seven Cities; set-tled among Quivira Indians where he established the first mission in what is now the s.w. U. S.; killed by Quiviras when he tried to con-vert nearby hostile tribes.

Padre (pä'drā) Island, long reef off coast of Texas T-56, map T-56

idua (păd'ū-à), Italian Padova (pä'dō-vä), Italy, educational and Padua art center and trade and manufacturing city on Bacchiglione River, 22 ml. w. of Venice; pop. 145,000; university (13th century) one of oldest in Europe: map I-156
Basilica of St. Anthony, pioture I-166 early medical school A-191

Giotto's fresco, picture P-15

Paducah $(p\dot{a}-d\vec{u}'k\dot{a})$, Ky., city in n.w. corner on Ohio and Tennessee rivers; pop. 33,765; large trade in leaf tobacco; farming, timber, and min-eral region; railroad shops, shoes, lumber, tobacco, textile manufac-tures: map K-11 Civil War C-253; map C-253

Paconius (pē-on'i-us) (5th century

B.C.), Greek sculptor; well known for statue of 'Victory': S-53

Paestum (pěs'tům) (originally Posidonia), Greek city on w. coast of Italy on Gulf of Salerno; founded 6th century B.C.; conquered by Romans 273 B.C.; destroyed by Saracens in 9th century; ruins of 3 Doric temples among most remarkable of antiquity.

Paganini (pä-āä-nē'nē), Nicolo (1784-1840), Italian violinist, born Genoa; early showed genius which caused him later to be hailed as "greatest violinist of all time"; devised own technique of fingering and bowing, famed for tone; composed violin concertos; great gambler, irregular life hastened death. Ignorant believed him devil's son.

Page, Thomas Nelson (1853-1922), American novelist and short-story writer and diplomat, born Hanover County, Va.; ambassador to Italy 1918-19; author 'Meh Lady', 'Marse Chan', 'Two Little Confederates', and other stories of Virginia life.

American editor and diplomat, born Cary, N.C.; editor Atlantic Monthly 1896-99, World's Work 1900-13: ambassador to Great Britain 1913–18 Hoover and H-334

Westminster Abbey memorial W-73 Page, William Tyler (born 1868), author of 'The American's Creed' U-224

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Paget Island, one of the Bermudas, picture B-100

'Pagliacei, I' (ē päl-yät'chē), opera by Leoncavallo, story O-232 Caruso as Canlo, picture O-234

Pago'da, a sacred tower, several stories high, usually connected with a temple, in countries of the Far East. See also in Index Temple Burma B-278, picture B-278a China C-221h, pictures A-275, C-221g Japan J-196, picture J-201 Tanjore, India, picture I-39 Thailand, picture T-73b

Pago Pago (päng'ō päng'ō), seat of U.S. government in Samoa; pop. 934: S-20, map P-10c, picture P-10d Pahang (pä-häng'), largest of Federated Malay States; 13,820 sq. mi.; pop. over 200,000; agriculture; tin and gold: M-43

and gold: M-43
Pahlavi (pär-lä-vë'), Reza Shah
(rä'zä shä) (born 1877), king of
Iran (1935-41), founder of Pahlavi
Dynasty. Started as leader of a
Cossack regiment in the Shah's
army; fought for rebel, Salzid Ziaud-Din, in revolution of 1921; became minister of war and reorganized the army; after Shah Mirze's came minister of war that ized the army; after Shah Mirza's flight in 1923 became premier; upon conquering north Persia in 1925 was elected to throne: P-132, 134

Palk-tu San, or Pai-shan, an extinct volcano in northern Korea, 8900 ft. high.

Paille-maille (pá'yű má'yű), aille-maille (pả'yũ mả'yũ), game which developed into croquet C-402 Pain, sense of T-116

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Paine, Albert Bigelow (1861-1997), American biographer and writer of stories for children; born New Bedford, Mass. ('Mark Twain, a Biography'; 'Joan of Arc—Maid of France'; 'Arkansaw Bear'). Paine, John Knowles (1839-1906), American composer, born Portland. Me.; professor of music at Harvard occupying first chair of music in an American university; compositions for orchestra ('Island Fantasy', "The Tempest'); chamber music; cantatas and songs; organ music: M-316

aine, Robert Treat (1731–1814), American lawyer and statesman; Paine. Robert Treat signer of Declaration of Independence.

Paine, Thomas (1737-1809), political writer and agitator P-12 'Common Sense' P-12, D-27-8

Painesville, Ohio, city on Grand River 28 mi. n.e. of Cleveland; pop. 12,-285; nurseries, alkali works; bas-kets, lye, coke, gas, cement; coal shipping.

Painlevé (păn-lŭ-vā'), Paul (1863-1933), French statesman and seientist, born Paris; active in politics, serving at various times as minister of public instruction and of inventions, minister of finance, minister of war, and premier; author of books on higher mathematics.

Painted bunting, or nonparell, a small bird of the finch family B-273

Painted cup. See in Index Indian paint brush

Painted daisy, a name for one variety Pyrethrum. See in Pyrethrum

Painted Desert, in N-22d, map A-289 in Arizona A-288,

Painted Porch, a porch in Athens in which Zeno lectured.

Painted terrapin, a fresh-water turtle T-168

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Pai-shan, or Paik-tu San, an extinct volcano in northern Korea, 8900 ft. high: map M-49a

Paisley (pāz/li), Scotland, manufacturing center on White Cart Water 7 mi. s.w. of Glasgow; pop. 87,000; noted Paisley shawls no longer made; textiles; thread-making center of Scotland; man Pagrag ter of Scotland: map E-270a

Paisley shawls, formerly made in Paisley, Scotland, in imitation of those of Cashmere

design from river, picture R-110 Paita (pd'ē-tā), Peru, a seaport with excellent harbor; pop. about 4000; cotton, tobacco, straw hats; exports petroleum; map P-140

Painte, or Piute (pi'yut), popular name for many small Shoshoneau Indian tribes or bands living in the desert region of s.w. Utah, s Nevada, and n.w. Arizona: I-54

reservations in Nevada N-77 story, 'The Dream of Chief Winne-mucka' N-79-80

Pakenham (pāk'ēn-ām), Sir Edward Michael (1778-1815), British gen-eral, born in Ireland, killed in Battle of New Orleans; veteran of Napoleonic campaigns.

Palace, Mayor of the. See in Index Mayor of the Palace

Palace of the Senators, Rome, picture R-139

Pulacio Valdes (pä-lä'the-ö väl-däs'), Armando (1858–1988), Spanish novelist, critic; keen analyst of emotions, sympathetic observer ('Sister Saint Sulpice'; 'Tristan'; 'José'; 'Joy of Captain Ribot').

Pala d'Oro (pä'lä dō'rō), Byza reredos or altar screen B-290

Palamedes (pāl-à-mē'dēz), in Greek mythology, Trojan War hero Odysseus and O-204

Pala Mission, near Oceanside, Calif., picture A-273

Pal'amon and Arcite (är'sīt), story of two Theban knights, prisoners of Theseus, king of Athens, They fall in love with Emily, sister-in-law of the king, and compete for her in a tournament. Palamon is defeated but Arcite, although victorious,

dies. After mourning him, Palamon and Emily are united. Early ver-sion of the story found in the "Teseide" of Boccaccio which is the source of Chaucer's 'Knight's Tale'.

Palanquin (păl-an-ken'), covered litter for carrying passengers India, picture I-33 Japan J-188d

Palate, the roof of the mouth; it consists of the hard palate in front and the soft palate behind; the former has a bony framework, while the latter is composed of muscular fibers inclosed by a movable fold of mucous membrane.

Palate bone, a bone forming part of the roof of the mouth S-156

Palat'inate, the name of 2 provinces in Bavaria, Germany: the Rhenish, or Lower, Palatinate (German Rheinpfals) in the west, a rich agricultural and mining region (2124 sq. mi.; pop. 931,755); and Upper Palatinate (German Oberpfals), in the east (3725 sq. mi.; pop. 629,262).

Palatinate, War of the, also called the War of the League of Augsburg or Grand Alliance, 1689-97. American phase of this conflict is known as King William's War: K-23

Palatine (păl'a-tīn) Hill, central and earliest settled of the 7 hills of Rome; its rectangular shape gave name Roma quadrata to primitive city founded, according to legend, by Romulus: R-128, R-144

by Romulus: R-128, R-144
Palau (pā-lou') Islands, also Pelew, archipelago (26 main islands) in Pacific e. of Philippines; part of w. Caroline Islands; 175 sq. mi.; discovered by Spanish 1543; sold to Germany 1899; made Japanese mandate 1919; strong naval and air base, headquarters for entire Japanese South Seas govt.; copra, sugar, breadfruit, bananas; bauxite, phosphates: man P-10b phosphates: map P-10b

phosphates; map P-10b native boy, picture P-248 Palawan (yū-lử/wān), westernmost of the larger islands of the Philip-pines; ranks 5th in size; 4500 sq. mi.: maps A-332c, P-10b Palazzo Vecchio (pū-lūt'sō věk'yō) (Old Palace), Florence I-169, pic-tures I-169, 171

Pale, in heraldry H-281

Pale, English, in Ireland I-126 Palearctic, one of the zoogeographical regions of the world Z-230

Palembang (yd-lėm-bäng'), port of Sumatra, Netherlands Indies; pop. 110,000; on Palembang River 45 mi. 110,000; on Palembang River 45 mi. from mouth; exports cotton, petroleum, kapok; makes silk, gold articles, weapons; fine Mohammedan mosque; cap, of Palembang province (33,342 sq. mi.; pop. 1,100,000); maps E-142, A-332c

Patencia, Isabel (born 1878), Span-ish diplomat; delegate of Spanish republic to League of Nations assemblies and to International Labor Organization conferences 1931-37; wrote 'Study of Child Psychology', 'The Sower Sowed His Psychology', 'The Sower Soy Seed', 'The Call of the Sea'.

Paleobot'any, the study of fossil plants F-161-3, 164, B-115 sequoia trees in Alaska A-102

Pale of Settlement, Jewish, Russian territory where Jews were allowed to live; the regulations, established 1791, were gradually modified, and in 1917 were all abolished.

Paleolith, man-made implement of

Old Stone Age M-47

Palcolith'ie Age, or Old Stone Age M-47, S-292, color plate M-48a-b

cave dwellers C-118-20 skeletal remains M-45-6

Paleontol'ogy, the science which treats of the fossil remains of plants and animals F-163, B-115. See also in Index Animals, prehistoric; Evolution; Fossils; Geology; Man Cuvier's contribution C-418

Paleozo'ie era, in geology G-40-2 Palermo (pä-lêr'mō), seaport and largest city of Sicily on n.w. coast; margest city of Sicily on n.w. coast; pop. 390,000; military post; exports fruit, sulphur; university: S-140, map 1-156 silks T-64

Pales (pā'lēz), in Roman mythology, a god or goddess of flocks and shep herds in whose honor the feast of Parilla, or Palilla, was celebrated on April 21, the day later said to be the founding date of Rome.

Palestine (pāl/ēs-fin), the Holy Land, s. part of Syria, 10,430 sq. mi.; pop. 1,600,000: P-33-7, S-361-2, maps A-242, A-332b, B-8 agriculture P-33, 35, A-58, picture

Bethlehem B-101 Christmas C-229c, pictures C-226 cities, list P-33 climate and rainfall P-35

Dead Sea P-34 Dead Sea F-32 flag F-96, color plate F-89 Hebrew language H-266-7, P-36 historic places F-33-5 history, chart H-297-9 Jews J-215-18. See also in Index

Jews

Herods, rule of H-287 Crusades C-403-6 World War P-33, 35, W-164 British mandate P-35-6 Jerusalem J-211-12 Jordan River P-33-4 peoples, modern P-36, 37 pilgrimages, medieval P-219 products, list P-33: brass work, pic-ture C-360 transportation P-35

Zionism P-36, J-218 Palestine, Tex., industrial city about 100 ml. s.e. of Dallas in agricul-tural region; pop. 12,144; cotton, oil, coal, furniture, fertilizer; railroad shops: map T-56

Palestrina (pä-lés-trē'nä), Giovanni Pierluigi da (1524?-94), Italian composer and reformer of Roman church music.

Paley (pā'lī), William (1743-1805), English clergyman and philosopher a clear and forceful thinker and writer ('Moral and Political Phi-losophy'; 'Evidences of Christian-ity'; 'Natural Theology').

Palgrave (pal'grāv), Francis Turner (1824-97), English critic and poet (anthology, 'Golden Treasury of (anthology, Gomes, Lyries'), English Songs and Lyries'), (Sanskrit "sacred

Pali (pä-lē') (Sanskrit "sacred text"), an ancient language of n. India, surviving in Burma, Ceylon, and Slam; language of Buddhism.

Palimpsests (pdl'imp-sests) (Greek "scraped again"), old parchment sheets on which the original writing has been erased to make room for later writing

Bible manuscripts B-104

Palisades (pāl-i-sādz'), The, on the Hudson River H-350, picture N-115 geologic structure N-114

Palissy (på-le-se). Bernard (1510?-89), French artist, potter, naturalist, and writer; one of first men in Europe to formulate correct theory of fossils ('Autobiography', one of the most interesting ever written):

platter by, picture P-335

Pal'la, Roman garment D-106, picture D-107

Palladino (päl-lä-de'nö), Ensania (1854-1918), Italian spiritualistic medium, celebrated through inves-tigations of Lombroso, Lodge, Lombroso, Myers and Münsterberg.

Palladio (päl-läd'ē-ō), Andrea (1518-80), Italian architect of late Ren-aissance, for whom the classical Italian style called "Palladian" is named.

Palladium (pä-lä'di-ŭm), a chemical element resembling platinum, table C-168

absorbs gases G-18 electrochemical activity E-239 gold A-133 platinum, found with P-247

Palladium, term applied to any image of Pallas Athena but especially to the one kept within the city of Troy (said to have fallen from Heaven) which was believed to be a safeguard of the city.

Pallas (păl'ds), in Greek mythology, a name of Athena A-353. See also in Index Athena

Pallas, an asteroid A-339

Palliser, John (1817-87), Canadian explorer, born Ireland; 1857-61 made scientific expedition through Canadian Saskatchewan and Alberta for British government, to find practicable road between east and west Canada.

Pall Mall (pěl měl), London street famous for clubs and palaces origin of name C-402

Pall-mall, a game C-402

Palm, a tropical tree P-37, pictures P-38-9

babassu, picture S-208i coconut C-292-4, P-6-7, P-37, G-181, pictures C-293, P-38, H-244 date D-18-19, P-37 picture P-38 dragon's blood from G-188

oil C-361-2, C-292, 294, F-19 royal F-116, C-410, picture P-39 sago S-4, picture P-38 trunk, internal structure T-131

vegetable ivory I-176, pioture B-287 Palma (päl'mä), Jacopo, or Giacomo (1480?–1528), Italian painter of Venetian school; called Palma Vecchio ("the Elder"); strongly influenced first by Bellini, later by Giorgione; work characterized by rich coloring and brilliant lighting.

Palma, Jacopo (1544?—1628), Venetian historical and religious painter, called "the Younger" to distinguish called "the Younger" to distinguish him from his great-uncle, "the Eider"; influenced by Titian; fine colorist, but works somewhat marred by technical mannerisms.

Palma (päl'mä), Ricardo (1833–1919), Peruvian writer L-67w

Palma, Tomas Estrada (1835-1908), Cuban patriot and general, first president (1902-06) of Cuban Re-

nublic.

Palma, Spain, port and cap. of Ma-jorca, largest of Balearic Isles, at head of Bay of Palma; pop. 95,000; lively trade; numerous manufac-tures; exports fruit, wine, and oil; Gothle cathedral with tomb of James II of Aragon: map S-226

Palmaceae (pāl-mā'sē-ē), the palm family of plants.

Palmas (päl'mäs), Cape, Liberia on w. coast of Africa, map A-42a Palmate (păl'māt) leaves L-89

Palma Vecchio, See in Index Palma. Jacopo

Palm Beach, Fla., fashionable winter resort on s.e. coast, on a peninsula; Palm oil P-37, F-19 cut off from mainland by Lake Palm Sunday E-140

Worth, an arm of Atlantic; residential pop. 3747: maps F-111, 112 beach, picture F-114

Palm cabbage, terminal bud of various palms, used for food.

Palm Canyon National Monument Project, in California N-22c

Palmer (päm'er), A. Mitchell (1872-Palmer (pām'ēr), A. Mitchell (1812–1936), American alien property custodian during 1st World War; attorney general in Wilson's cabinet 1919–21; born Moosehead, Pa. Palmer, Alice Freeman (1855–1902), American educator, born Colestin V. Paneidant of Wellesley

American educator, born Coles-ville, N. Y.; president of Wellesley College 1882-87, non-resident dean women, University of Chicago, after 1892.

Almer, Erastus Dow (1817-1904), American sculptor, born Pompey, N. Y.; well known for figures and Palmer. Erastus portrait busts; 'The White Captive' in Metropolitan Museum of Art, New York City: S-62

Palmer, George Herbert (1842-1933), American educator, born Boston; professor of philosophy at Harvard University until 1913; married Alice Freeman in 1887; wrote 'Life of Alice Freeman Palmer'; philosophical works, essays.

Palmer, John McAuley (1817–1900),

American soldier and politician, born Eagle Creek, Ky.; major gen-eral commanding division at Mur-freesboro and Chickamauga; corps commander in Atlanta campaign; governor of Illinois 1869-78; U.S. senator 1891-97; Gold Democratic candidate for president 1896.

Palmer, Nathaniel Brown (1799-1877), American sea captain and explorer; born Stonington, Conn.; when in command of whaling vessel, left South Shetland Islands on exploring voyage and discovered Palmer's Land in Antarctic (1821); commanded and designed clipper ships; retired 1849 and be-came director Fall River Line.

Palmer, Alaska, a district in s., including the villages of Palmer and Matanuska, about 50 mi. n. of Sunrise; pop. 1441; center of Alaska Rural Rehabilitation Corporation; as 3-story community center, railaged station, payed streets, and a road station, paved streets, and a weekly newspaper: A-104

Palmer, pilgrim returning from Pal-estine P-219

Palmerston (päm'ēr-ston) John Temple, 3d Viscount (1784-1865), English statesman, foreign minister 1830-41, 1846-51; home secretary 1852-55; prime minister (Whig) 1855-58, 1859-65; though of an ardent, contentious, sometimes erratic temperament, he had lofty conception of his and England's duties; friend of o Victoria reprimands V-295 oppressed

Palmetto (păl-měťő), a fan palm P-37 Palmetto State, popular name for South Carolina P-37

Palmistry, the art of reading the character of a person and foretelling events by the lines and elevations in the palm of the hand; an ancient art, once believed important, it is now considered a pseudo science; also called chiromancy.

Palmitic (păl-mit'ik) acid, a fatty acid F-19

Pal'mitin F-19

Palmito, Tex., scene of last battle of Civil War (May 18, 1865); in ex-treme s. point of state, on lower Rio Grande near Palo Alto.

Palm oil P-37, F-19

Palmyra (păl-mi'ra). Syria; cap. of former kingdom: P-40

population in ancient times D-113a-b Palmyra Island, a U-shaped atoll consisting of 53 islets about 1000 mi. s.w. of Hawaii; about 500 acres; first discovered 1798; taken over by U. S. 1898; until taken over by U. S. Navy in 1940 was under the jurisdiction of the city of Honolulu U. S. naval base N-52, map N-52

Palmyra palm, a magnificent and valuable palm (Borassus flabellifer), common in India and nearby islands; named from city of Palmyra.

Palo Alto (pā'lō ăl'tō), Calif., city 30 mi. s.e. of San Francisco; pop. 16,774; U.S. Veterans' Hospital; Stanford University

L-106h, picture

children's library

Palo Alto, plain in s. Texas 8 mi. n.e. of Brownsville; Gen. Zachary of Brownsville; Gen. Zachary Taylor defeated Mexicans in Mexican War battle (May 8, 1846).

Palolo (pä-lō'lō) worm, an annelid found in waters near Samoan and Piji islands, swarms to surface in October, caught and eaten by the natives; found also near Dry Tortugas and Puerto Rico where it rises to surface in June or July.

Palomino horse, a popular type (not a breed) of saddle horse characterized by color, which varies from orange-gold to ivory, and light-colored mane and tall; black hoofs and white "stockings" half-way to knee are considered ideal markings.

Palos (pä'lōs), Spain, Atlantic sea-port on s. coast 55 mi. s.w. of port on s. coast 55 mi. s.w. of Seville; Columbus sailed from Palos Aug. 3, 1492; pop. 2000: map S-226 Palo verde (pä'lő věr'da) tree, an intricately branched tree (Cereidian Palos Verde) um torreyanum) of the pea family; native to arid desert lands of Calinative to arid desert lands of Callfornia, Arizona, and Mexico; from 15 to 20 feet high; has smooth green bark, small leaves, which soon fall, and showy clusters of yellow flowers that are followed by beanlike pods; also called

green-barked acacia. Palpi, mouth parts, as of butterfly or mosquito, pictures B-285, M-266

Paludan-Müller (pä'lu-dän mül'ler) Frederik (1809-76), Danish poet ('Adam Homo', narrative epic in 3 vols.; "The Dryad's Wedding' and "The Death of Abel', idylls;

'Kalanus', poetic drama).
'Pam'ela, or Virtue Rewarded', novel by Richardson; story of a simple country girl whose master, failing to seduce her, marries her: N-182 Pamir (pä-mir'), plateau in cent.

Asia A-324 Pamilico (pām'li-kō) Sound, N. C., largest of the lagoons on Atlantic coast of U. S.: map N-156 canvasback ducks D-117

Pampa, Tex., city 55 ml. n.e. of Amarillo, in agricultural district; 12,895; oil and gas, carbon black,

gasoline, creamery products, grain.

Pampa, grassy plain A-278-9, S-208h,

maps A-279, S-208d, picture A-280

Indians S-206 wild life S-208k

Pam'pano, or pompano, a fish F-75 Pampas deer, a small South American deer; average height about 21/2 ft.

Pampasgrass, a perennial plant (Corampagrass, a pereintal plant (Corrataderia selloana) of the grass family, native to plains of Brazil, Argentina, and Chile. Grows to 7 ft., in clumps, with the narrow reedlike leaves and tall stems towned by purely adverse topped by plumelike clusters,

silvery white to pink; used as an ornamental plant.

Pamphili. See in Index Eusebius of Caesarea.

caesarea
amphylia (pām-fil'i-à), ancient
mountainous region on s. coast of
Asia Minor; successively under
rule of Lydia, Persia, Macedon,
Syria, and Rome; chief cities were
originally Greek colonies. Pamphylia

Pan, in Greek mythology god of flocks and pastures, fields and for-ests P-40

Midas and M-158

Panacea (pān-à-sē'à), goddess of all healing, daughter of Aesculapius

Panacea, a remedy or medicine purporting to cure all diseases H-370

Panama (păn-à-mä'), cap. and chief Pacific port of Republic of Pana-ma, on Gulf of Panama at s. terminus of Panama railroad; pop. 83,000: P-41, map C-132, pictures P-41, 42. See also Central America exploration E-346

Panama, Declaration of L-67p

Panama, Gulf of, maps C-132, P-52 Panama, Isthmus of, strip of land connecting North and South Amer-ica; runs e. to w. in form of an S; usually regarded as co-extensive with Republic of Panama; average width 70 mi.; old name, Isthmus of Darien: P-41, maps C-132, P-52, N-150c

Balboa first white man to cross B-15

early history P-43

Panama, Republic of, the southern-most of the Central American states; 32,380 sq. ml.; pop. 535,000: P-41-2, C-1 N-150a, c canal P-43-53 climate P-41 C-131-4, maps C-132.

climate P-41 flag F-96, color plate F-89 history P-41: United Sta P-43, 44, 46, 53, R-150 Independence Day H-322 natural features P-41, P-43 States and

products P-41: tagua nuts B-287

Panama-California Exposition, held at San Diego, Calif., 1915-16, to cele-brate the completion of the Panama

Panama Canal P-43-53, U-189, maps -132, N-150c

Champlain suggests canal C-138-9 channel buoys A-7 Clayton-Bulwer treaty A-314, T-20 construction P-46-52: Goethals G-109

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distance saved P-53 foreign nations' use of P-53 Hay-Pauncefote Treaty M-16

length P-52 locks P-48, P-52-8, pictures P-47, P-49-51

payment to Panama P-42, 44 sanitation P-46, picture P-45: Gorgas

South American trade aided S-2066 strategic importance P-53, C-131,

N-51, map N-52 Suez compared with S-318 T. Roosevelt begins R-150, P-46 time required for passage P-52 tolls P-52

Tolls Act repealed W-108
trip through Canal P-52-3
type of dredge used D-104
U.S. buys French rights P-44
western Canadian commerce V-271

Panama Canal Treaty (1903) P-53. See also in Index Treaties, table Panama Canal Zone. See in Index Canal Zone

Panama City, Fla., seaport in n.w. on St. Andrew's Bay, 7 mi. from Gulf of Mexico; pop. 11,610; fishing, yachting, water sports; lumber and paper mills, oil terminals: map 17-112

Panama Congress (1826) A-15

Panama hats H-235 making H-235: Ecuador, picture L-67f; Puerto Rico, picture P-311 Panama-Pacific International Exposi-

tion, world's fair held at San Francisco, Calif., Feb. 20 to Dec. 4, 1915, to celebrate opening of Panama Canal; 36 foreign nations particiarea of grounds 635 acres; pated: cost \$50,000,000

\$50 gold pieces M-197 Panama Tolls Law W-108 Pan American Airways A-89-90 Atlantic clipper, picture A-88

transpacific route P-9 Pan American Conferences, meetings of delegates from countries of South, Central, and North America, and West Indies to consider various questions of interest mutual -670-r

F. D. Roosevelt M-242, R-146n, Pan American Day, celebrated April 14, for on that day in 1890 the Pan American Union was formed; a legal holiday by presidential procla-mation 1981: L-67r, H-320

Pan American Exposition, held at Buffalo, N.Y., May 1 to Nov. 2, 1901, to illustrate progress of civilization in Western Hemisphere in 19th century; area of grounds 350 acres; attendance 8,179,674; cost \$8,860,-757; gatereceipts \$5,534,643; McKinley assassinated while holding a re-ception in Temple of Music.

Pan American Highway M-142, R-114,

Pan American Union, official organization of the republics of North, Central, and South America, and West Indies maintained at Washington since 1890 for development of commerce and preservation of friendship and peace: L-67q-r headquarters, picture L-67r

Pan'amint Range, Calif., n. and s. range, east of Sierra Nevada Moun-Valley; Panamint Peak highest point (6605 ft.): picture C-32

Pan-Arab movement A-242

Panathena'ie Festival, oldest and most important of ancient Athenian festivals, in honor of Athena A-353

Parthenon frieze A-11-12, pictures A-352, G-168

A-352, G-168

Panay (pā-nā'ē), an island nearly in the center of Philippine group, 6th in size (4448 sq. mi.); Iloilo chief city, 250 mi. from Manila; fine grazing land; sugar, rice, copra; deer abound: maps A-332c, P-10b

'Panay', American gunboat sunk by Japanese R-146k

Panchatantra (pün-ohà-tūn'trà), an ancient collection of Sanskrit fa-bles; originally designed for the moral and ethical instruction of princes; source of many European fables; S-301, 303a quoted S-300

Panchromatic film P-185, M-289 Pancreas (păn'krē-ās), a gland in the abdomen G-99, 100

function in digestion D-69, P-207 Panda, rare mammal (Ailuropoda melanoleuca) ranging from Eastern Himalaya to northwest China great, or short-tailed Z-222; discovery of E-346

long-tailed Z-222, picture Z-224 Panda'nus tree, tropical tree or shrub, also called screw-pine because of spiral arrangement of leaves: P-5

Pandarus (pān'dā-rūs), in Greek legend a Lycian, hero of Trojan War, distinguished as an archer; slain by Diomedes; in Shake-speare's 'Troilus and Cressida' acted as an intermediary in love, hence the word "pander.

'Pan'dects', of Justinian J-231

Pandemonium (pān-dō-mō'nī-ūm) ("all the demons"), in Milton's 'Paradise Lost' the capital of Hell where Satan and the lesser devils met in council; term applied to a noisy or disorderly place.

Pando'ra, in Greek mythology, the first woman P-53-4

Pangalos (päng-gä'lōs), Theodore (born 1878), Greek general and politician; chief of staff of army 1918-20; by coup d'état established dictatorship 1925; overthrown by General Kondylis 1926.

Pangani (pän-jä'nē), Tanganyika Territory, seaport and center of caravan trade; pop. 3000: map Tanganyika

TO-190

Pangborn, Clyde, American aviator, made Japan-to-Washington flight picture A-73, table A-74

Pan-Germanism, a movement to unite Germans all over the world into groups for the promotion of Ger-man ideals and territorial expansion, organized in 1891 and given name of Pan-German League in 1894; later developed into movement for world domination.

Pan'gloss, character in Voltaire's 'Candide'. See in Index 'Candide'

Pangolin (păng'gō-lin), or scaly ant-eater, several species of toothless mammals of family Manidae: Z-222 Panhandle, of Texas T-57

part ceded to Oklahoma O-219 Panhandle State, popular name for West Virginia, formerly applied to

Idaho.

Pan'icle, a compound flower-cluster T-121

Panies and depressions, economic. A list of panics in the United States will be found in the table on the following page automobile industry's

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bank failures B-43 causes H-336 Federal Reserve system F-21 Germany G-75-6 international trade

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1873: Grant and G-133; end under

Hayes H-252-3
1893 C-266-7; threatened in Harrlson administration H-231; Mc-Kinley campaign M-14 1907 R-151-2 1921 H-219-20

1929 H-336-7, U-250, 251: drought period D-113c, Roosevelt's re-covery measures R-146c-j, A-56b,

S-179
Panicum (pān'i-kūm), a genus of grasses including millets M-176
Panjim (pān-zhēn'), also Nova Goa, seaport and cap. of Portuguese India, in Goa on w. coast of India, about 250 mi. s. of Bombay; pop. 24,000: map A-332c
Pank'hurst, Christabel (born 1880), English suffragette W-132

ank'hurst, Christabel (born 1880), English suffragette W-188 Pankhurst, Emmeline (1858-1928),

PANICS IN THE UNITED STATES

Economists make a distinction between panies, crises, and depressions. An industrial or financial crisis reaches its peak in a panic, when commodity and security prices fall sharply. The panic is usually followed by a period of depressed activity and readjustment, until confidence is restored and business again reuches a normal level. Almost invariably a crisis is preceded by a period of abnormally high activity, when prosperity is accompanied by inflated prices of commodities, of securities, and of real estate. The earlier crises or panics were mostly the result of European difficulties, and were not so severe or widespread in the United States. In 1793 the unexpected declaration of war between France and England was followed by troubles for American shipping, and caused a period of decline. Again, after 1802, the peace of Amiens was followed by maritime prosperity, to be ended abruptly by the Embargo and Non-Importation troubles in 1807 and 1808. The War of 1812 brought industry in the United States to a low point, from which it recovered rapidly for several years, only to suffer a slump in the years 1819-22. The first major panic and crisis came in 1837.

1837. The era of internal improvements, of building canals, railroads, and roads, involved excessive extension of credits by banks and unwarranted borrowings by the state governments. A crisis was precipitated by the refusal of Congress to renew the charter of the Bank of the United States. This was the signal for an outburst of fear; many banks closed, business firms failed, and industry was paralyzed. Some of the states repudiated bonds issued for the payment of improvements, and depression continued for seven or eight vegars.

1857. After the Mexican War and the discovery of gold in California, the United States went through a period of deflation, during which interest rates declined and speculation increased. Railroads were built on a scale far beyond the country's immediate need. Then came panic. Several large life insurance companies failed, and depression continued, with a short interruption during the war years, until the new industrial development in the late 60's and early 70's.

1869. The money panic of this year reached its climax on September 24, "Black Friday," in the attempt of Jay Gould and Jim Fisk to corner the gold supply of the United States. At the peak, \$1.63 in greenbacks was required to buy \$1.00 in gold. The effects were limited to the financial centers, and there were no general disturbances throughout the country. At the same time, however, European markets were disrupted by the opening of the Suez Canal.

by the opening of the Suez Canal.

1873. A new period of inflation began about 1868. In the next five years over 30,000 miles of railroad were built. Joint stock companies were taking the place of old-fashioned partnerships. Industrial expansion was going on at a feverish rate. In Europe during the same years, following the Franco-Prussian War, there was great expansion in Germany and Austria, culminating in the 'Vienna crash' of 1873. The break in the United States was begun by the failure of Jay Cooke & Company. General business and financial deflation was followed by the worst depression the United States had yet seen. This low period continued for about six years, until a new burst of activity which followed the resumption of specie payments in 1879.

1884. The panic of 1884 was a money and bankers' panic, precipitated by the failure (May 8) of the firm of Grant and Ward, of which Gen. U. S. Grant was a partner. The resulting depression was not severe and lasted only about two years.

1890. This was another bankers' panic, brought on by the failure of Baring Brothers, the great London firm of international bankers, with very close connections in New York and Boston. Baring Brothers failed November 10. The Bank of

England and a strong private banking firm came to their rescue, and the effects of the crisis were slight.

1893. The panie or crisis of 1893 was caused by agricultural depression, by unsound railroad financing, and perhaps even more by uncertainty about the financial stability of the United States. The operation of the Sherman Silver Purchase Act was obviously endangering the gold reserves of the treasury. Many banks failed, 20,000 miles of railroad went into receivership, and the following economic depression was prolonged and severe, including grave labor disturbances in the east and middle west. One of the consequences of this period was the formal adoption of the gold standard by the United States (March 4, 1900).

1901. Stock market panic, culminating May 9, as the result of a struggle between the Harriman-Kuhn-Loeb interests and the Morgan-James J. Hill group for the control of the Northern Pacific Railroad. The stock of this railroad was cornered, and the collapse of the corner was followed by a general collapse in security prices.

1907. The panic of this year was a money panic, sometimes called the Knickerbooker Trust panic, because the failure of that company (October 22) precipitated it. The financial difficulties of that company and of others which failed were caused chiefly by the efforts of the Heinze group to combine control of various banks, copper companies, and other interests.

ests.

1914. The outbreak of the first World War was followed immediately by panie in all the financial centers of the world. Stock and grain exchanges were closed in New York, Chicago, and other cities. Clearinghouse certificates were used between banks in settling balances, and the treasury immediately made available, under the Aldrich-Vreeland Act of 1908, an ample supply of emergency bank notes, thus enabling the banks to meet the demand for cash while at the same time husbanding their gold reserves. Unlike most panies, this one was followed by a sharp expansion in business activity, made necessary by the Allied demand for supplies and munitions. This activity was greatly increased when the United States entered the war

was gready increased when the United States entered the war 1921. The year 1921 marks a new crisis and the beginning of the "primary post-war depression." The end of the war found the United States with overexpanded facilities for production, and with an accumulation of food and material of all kinds which Europe could not use. One result of the situation was a sharp break in wholesale commodity prices, notably sugar. Readjustment and depression on a minor scale continued for several years until the turn which came with the "Coolidge prosperity" and reached its peak in the "bull market" of 1929.

1929. The years of the Coolidge administration witnessed expansion and inflation on a scale hitherto unknown in any country in the world. Inflation in wages, real estate values, and stock prices, seemed to bring prosperity to everyone. While financial activity continued at an unprecedented rate through the summer of 1929, industrial activity was already slowing down. The collapse of the speculative mania in the stock market was slowly followed by a realization that in the United States as well as in other parts of the world many grave economic and financial problems had not been faced. These were now to cause the most serious disarrangement of economic structure which the world has yet known. Agricultural depression, the result of falling prices for farm products and for land cost thousands of farmers their homes through foreolosure. Unemployment and bank failures were greater than ever before in American history. The domestic factors were complicated by foreign affairs, such as reparations and the questions of inter-allied debts.

English militant suffrage leader; founded in 1903 Women's Social and Political Union, and, with her daughters, Christabel and Sylvia, led campaign of suffragette violence: W-133

Pankhurst, Sylvia (born 1882), English suffragette W-133

P'an Ku, in Chinese legend C-221i
Pannonia (pā-nō'ni-ā), province of
Roman Empire, lying s. and w. of
Danube River; Illyrians were probably original inhabitants.

Panor'pa. See in Index Scorpion fly Pan'sa, house of, picture P-301

Pan-Slavism, movement toward political and cultural union of nations of Slavic descent; has played important part in politics of cent. Europe; movement is chiefly opposed to Magyar and German influence; congresses held 1848 at Prague, 1867 at Moscow, and 1908 at Prague.

Pan's pipes, musical instrument W-135, pioture M-322

forerunner of pipe organ O-250 Pansy (Viola tricolor), a flower P-54 explosive seed-pods S-73 how to plant G-11

Pantag'ruel, giant in Rabelais' satire 'Gargantua and Pantagruel' R-9

Pantaloon, character in old Italian comedy representing San Pantaleone, patron saint of Venice; portrayed as a foolish old man who wore spectacles and slippers and long trousers which ended in stockings; character later used in pantomine; term also applies to certain kind of 'trousers, whence "pants."

Pantelleria (pän-těl-la-rě'ä), volcanic

island in Mediterranean 62 mi, s.w. of Sicily; belongs to province of Trapani, Sicily: 45 sq. mi.; chief town, Pantelleria (pop. 9000): map E-326d

Pan'theism, belief that the universe as a whole is God in Brahmanism H-293

Panthéon (püń-tā-ôn'), Paris, formerly church of Ste. Geneviève, begun 1764; secularized at Revolution and dedicated to great men of nation; later again used as church but finally secularized by decree of 1885; burial place of many eminent men of France

earth's rotation proved in E-132-3 mural painting, picture M-159 victor Hugo buried in H-352, 353 Pan'theon (păn'thē-ŏn), Rome A-261, R-146, E-331, picture A-260 Pan'ther, name applied to leopard, especially larger forms of southern Asia, and also to the puma. See also in Index Leopard; Puma

cat family characteristics C-95-6 'Panther', German warship M-259

Pan'tomime (from Greek meaning "all imitating"), a play in which a story is told by gestures and dancing without words, often accompanied by singing or music; of ancient origin

Columbine and Harlequin C-316 Pantothenic acid, a vitamin V-311a,

Pánuco (pä'ng-kō) River, in e. cent. Mexico; flows into Gulf of Mexico at Tampico: M-141

anurge (på-nivzh'), companion of Pantagruel in Rabelais' 'Cargantua and Pantagruel'; has wit and intel-Panurge (på-nürzh'), ligence but no moral principles.

Panza, Sancho (păn'za, săng'kō, Spanish sän'kō pän'thä), squire in Cervantes' 'Don Quixote' C-136

Panzer divisions, in U.S. Army A-307b Panzini (pünt-sē'nē), Alfredo (born 1863), Italian novelist; a prolific writer, at his best in autobiographical novels and short stories, such as 'Il Mondo e Rotondo' (The World is Round) and 'Le Flabe della Virtu' (The Fables of Virtue).

Paoli (pä'ō-lē), Pasquale (1725-1807), Corsican general, patriot; a leader in rebellion against Genoese and French rule of Corsica; head of government 1757-68; increasing French control forced flight to England; during French Revolution re-turned as governor, remained until British occupied island.

Paolo, Niccolo di, Italian metal worker, picture M-125

Papacy P-54-6. For list of popes see in Index Pope, table origin P-54: St. Peter P-141

Eastern church breaks away C-232 feudalism and F-29 temporal power P-56

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conflict with Frederick I F-190 submission of John of England J-222 struggle with Frederick II F-190 conflict with Henry II of England

supports Guelfs G-182, F-107 Babylonian Captivity B-174, P-163, G-177

Great Schism U-261: Council of Con-

stance H-363 Inquisition I-80 Luther attacks L-220, 221 Reformation R-65-7 Henry VIII defles II-278 Counter-Reformation R-67 Italian unity and I-157, 158 loses temporal power P-227, P-56 temporal power restored (1929) I-158, P-227 Lateran Treaty P-227

Papago (pä'pä-gō), Indian tribe of Piman family living in s. Arizona and Mexican state of Sonora I-55

houses I-60 Papaloapam (pä-pä-lō-ä'päm) River, in Mexico, rises in mountains of Oaxaca; unites with San Juan and empties into Gulf of Mexico.

Papal orders of knighthood D-35

Papal States P-56, I-158. See Papacy gift of Pepin R-53 Julius II enlarges J-228: Bologna added B-170

Papa'ver, the poppy genus P-304, O-234-5

how to plant, table G-11 Papaw, or pawpaw (pq-pq', or pq'pq), a North American tree or shrub of custard apple family; has bananashaped, edible pulpy fruit; grown in south, east, and middle U. S.; also name given to papaya.

Papaya (pä-pä'yä), also called paw-paw, a tree with melon-like edible fruit, native to tropical America, now found in almost all tropical regions; grown successfully in s. Florida; a source of papain, a digestive ferment; fruit used for cosmetics and foods, bark for rope; juice of fruit a popular drink.

Papeete $(p\ddot{a}-p\ddot{a}-\ddot{a}'t\ddot{a})$, seaport on island of Tahiti; cap. of Society Islands and all other French islands of e. Pacific; pop. 9000, about half French: map P-10c

Papen (på'pēn), Franz von (born 1879), German statesman; military attaché in U.S. 1914, but expelled for sabotage and esplonage; chancellor of Germany May to Nov. 1932, vice-chancellor 1933-34; intrigues while special envoy to Austria helped effect that country's fall; directed Nazi activities in Turkey while ambassador there 1939 -..

Paper P-56-61 aluminum coated A-138 Arabs introduce into Europe C-247 beginning of use of B-180 bleaching B-155, picture P-59 blue print P-186

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C-123; mulberry bark M-298; papyrus P-56-7; pine P-61, P-220, P-245b-c; spruce S-265 measure, table W-68

microscopic structure, picture M-157 money made of M-222. See also in

Index Paper money newsprint P-57-61, P-220 sizes of P-61 testing quality, picture P-58 wall paper W-3-5 wasps' nests W-32, pictures W-33

Paper birch, or canoe birch B-119, picture C-75 "Paper" blockade B-157

Paper measure, table W-68 Paper money M-220b, 221, 222 American colonies A-159 average life of a bill M-222 banknotes M-220b, 221, B-43: Fed-eral Reserve F-22; "wildcat" banks, Civil War period B-44 Confederate, picture M-220a Continental Congress issues M-220b,

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U. S. treasury notes M-221, 222 Paper mulberry, a bushy mulberry used in paper making M-298 tapa cloth M-298, picture C-275

Paper nautilus. See Argonaut Paper-shell almonds A-133

Paphlagonia (păf-là-gō'ni-à), ancient country of Asia Minor on Black

Sea; subdued by Croesus; later became part of Roman provinces of Galatia and Bithynia; made separate province by Constantine.

Paphos $(p\bar{a}'f\bar{o}s)$, name of 2 ancient cities on w. coast of island of Cyprus; Old Paphos, founded about 10th century B.C., was chief seat of worship of Aphrodite; New Paphos was cap. of island in Roman times.

Papier-mâché (páp-yā' mä-shā'). per product resembling wood P-61 matrix for stereotype plates S-287 shoe buttons B-288 taxidermy T-18

Papil'la, in anatomy, minute, conical elevations

skin (tactile) S-157, H-207 tongue (taste buds) T-107, T-16

Papillon (på-pë-yōn), Jean (1661-1723), French wood engraver; about 1688 invented method of making wall paper from engraved wood blocks

wall paper W-4

Papillon, or butterfly dog D-83

Papin (på-päň'), Denis (1647-1712?), rench physicist; greatly improved air pump, conceived idea of pneu-matic transmission of power, in-vented the digester; pioneer in steam navigation piston engine S-280

Papinoau (på-pē-nō'), Louis Joseph (1786-1871), leader of French-Canadian rebellion of 1887; leader of Sons of Liberty: P-61

Papini (pä-pē'nē), Giovanni (born 1881), Italian writer and editor, born Florence; works include essays, poems, novels, biography, and range from iconoclastic and sceptical to mystical ('Four and Twenty Minds'; 'Life of Christ'; 'Fail-

Papoose', a North American Indian baby or young child I-69-70, pic-tures I-69, I-52

Paprika (pä'prē-kā), a red pepper, much used in Hungary P-119-20

Papua (pil'pu-à), Territory of, s.e. New Guinea and neighboring is-lands; 90,540 sq. ml.; pop. 250,000; administered by Australia; formerly called British New Guinea: N-85, maps A-372a, P-10b soldiers, picture N-83

Papuan race, or Melanesian race East Indies E-142b-c New Guinea N-84, picture N-83

Papyrus (pà-pi'rŭs), a plant and the paper made from it P-62 books B-175, 178

manuscripts, pictures B-102, G-173 paper P-56-7

Pará, most northern seaboard state of Brazil, containing mouth of Amazon River; 526,241 sq. mi. pop. about 1,500,000; cap. Belém; cacao, timber, rubber, tobacco, manioc.

Pará (pů-rů'), seaport in n. Brazil on Pará River; officially known as Belém. See in Index Belém

Para, a minor coin; in Turkey and Cyprus 1/40 plaster, in Yugoslavia 1/100 dinar.

Para-amino-benzoic acid V-311a

Par'able, a brief narrative or allegory which is founded on every-day happenings and which conveys a spiritual or moral truth; the Bible contains good examples ('The contains good examples ('The Prodigal Son', 'The Good Samaritan').

Parab'ola, a plane curve so drawn that any point on it is distant by the same amount from a fixed point called the focus and a fixed line called the directrix. See also in Index Conic sections

Paracelsus (pår-å-sěl'sůs), assumed name of Theophrastus Bombastus von Hohenheim (1493–1541), German-Swiss physician and chemist; scientific theories, though mixed with superstition, were advanced for his age; one of the first to apply the mixed the state of predictive to the state of the stat chemistry to the study of medicine; hero of Browning's poem 'Paracelsus': C-178

Parachute (păr'a-shut), apparatus for making safe descents from aircraft P-62, pictures P-62, 63

Parachute troops, or paratroops, P-62, pictures P-63 hattle of Flanders W-178h-i Crete W-178q, picture W-178r

Paradise, a Persian word for royal park or garden; used by Greek translators for Garden of Eden.

Paradise birds P-62, 66, color plate P-64-5

Paradise fish A-235

'Paradise Lost', epic poem by Milton M-178, 179-80 M-178, 179-80 Milton dictating, picture M-178 verse form used P-269

Paradox Valley, on w. edge of Colo-rado about 50 mi. s.w. of Grand Junction; extends into Utah carnotite deposits C-311

Paraffin P-66, W-58 base P-148-9: source of P-152 melting point, table F-194 process of obtaining P-149

Paraffin series, in chemistry, group of hydrocarbons beginning with methane (CH₄) and continuing step by step to more complex compounds. each of which is distinguished from the preceding one by possessing one more carbon atom and two more hydrogen atoms; the series runs methane, ethane, propane, butane, pentane, hexane, heptane, octane, nonane, decane, etc. petroleum bases P-148-9 structural formulas C-176a use as fuels P-150

Paraform, form of formaldehyde F-159

Paraguay (pār'ā-fwā), a country of South America; 155,000 sq. mi,; pop. 1,000,000; cap., Asunción pop. 1,000,000; cap., P-66-7, maps S-208b-c, d, Outline

cities P-67 flag F-96, color plate F-89 history P-66, 67: boundary dispute with Bolivia P-67 literature L-67w

products and industries P-66, 67 transportation P-67

Paraguay-Parana Plains S-208h, map

Paraguay River, chief tributary of the Parana; rises in s.w. Brazil, flows s. through Paraguay; length about 1500 mi.; chief commercial outlet for Paraguay: A-280d, maps S-208b-o, B-226, A-279

Paraguay tea, maté or yerba maté T-22, 27, picture S-205c

Parnhyba (pā-rā-ē'bā) do Norte, Bra-zil, state on central seacoast; 21,-591 sq. mi.; pop. about 1,300,000; 591 sq. mi.; pop. about 1,800,000; cap. Parahyba; cotton, sugar, wax.

Parakan, ancient Indian tribe of Peru, named after location, Parakas, where mummies were found E-346

Parakeet, See in Indew Paroquet
Parallax, the apparent difference in
position of a heavenly body when
seen from two different points
\$-273, A-339

Parallel circuits, in electricity E-215, diagram E-223

Parallelepi'ped, in geometry G-49 Parallel'ogram, in geometry G-49 measuring area M-115 Parallelogram of forces, in physics

P-191 Par'allels, of latitude L-70

Paral'ysis brain injury causes B-223-4 infantile, infectious G-80

Paramaribo (păr-à-măr'ē-bō), cap and trade center of Dutch Guiana S. A.; pop. 50,000; on estuary of Surinam River 17 mi. from sea; good harbor, two forts: map G-183

Parameeium, a single-celled animal shaped like slipper; has hairlike cilia for movement and primitive gullet; common in fresh water how it responds to stimulus, picto-

graph N-64a

Parana (pä-rä-nä'), seaboard state of s. Brazil; 77,180 sq. mi.; pop. about 1,000,000; cap. Curitiba; yerba 1,000,000; cap. Curitiba; maté, timber, coffee, cereals.

Parana, Argentina, port on Parana River 285 mi. n.w. of Buenos Aires; pop. 150,000: map A-279

pop. 150,000: map A-279

Paraná pine, evergreen tree (Arancaria brasiliana) of pine family, native to Brazil. Grows 80 ft. to 130 ft.; trunk branch-free nearly to upper third of length; crown flat. Leaves oblong and pointed to 2 in. long; cone globular. Wood soft, yellow, decays readily; used for building, matches, and pulpwood. Sometimes called arancaria: S-208k

Parana River, important river of South America; rises in s. cent. Brazil; flows s.w. about 2000 mi. to Plata estuary: P-246, A-280d, maps B-226, S-208b-c, A-279

Pará nut, another name for Brazil nut N-187

Para River, Brazil, estuary of the Tocantins and also one of the mouths of the Amazon, map S-208b Para rubber R-166

Parasites (păr'a-sīts) P-67-70, B-114 body louse P-67-8, picture P-69 disease germs G-77-80: tsetse fly, carrier T-148

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chigger S-258, picture P-68 mosquito as host M-267-70 mussel larvae C-259 scale insects S-34-5 stylops, a kind of beetle B-85 worms W-180a-b: hookworm H-333

Parasol ants, or leaf-cutting ants, ptoture A-213 Parathy'rold, a gland G-100

Paravane, device to protect ships from mines T-116

Parcae (pdr'sē), Latin name for the three Fates F-18

Parcel post P-318, P-322 Parchment, goat, sheep, or calf skin prepared for writing P-57, B-176

Parchment lacturius, a mushroom, color plate M-306a-b Parchment paper P-61

Pardo Bazan (pär'dō bā-thün'), La Condesa Emilia (1852-1921), Spanish author; colorful style; charming pictures of Spanish country life; strongly influenced by French naturalism ('La Madre naturaleza'; Los Pazos de Ulloa'; 'Insolación'; Pardon, for prisoners P-350, U-215 Pardoner's tale, in 'Canterbury Tales' C-162

Paré (pä-rā'), Ambrolse (äň-brwäz') (1517-90), surgeon, born Laval, France; called the father of modern surgery; introduced practise of ligature of arteries in place of cautery in amputations; court physician to Henry II, Francis II, Charles IX, and Henry III.

Parenchyma (på-rčn'ki-må), the parent tissue of plants, composed of thin-walled cells containing active protoplasm, the tissue in which nutritive work is carried on, and from which all other tissues are derived

leaves L-90 Parental schools S-40

Paren'thesis, use of P-368 'Parents' Assistant', story book by Maria Edgeworth L-159 Parent-Teacher Associations P-70

Pareto, Viifredo (1848–1923), Italian economist and sociologist, born in Paris; practised engineering for 20 years; in 1894 became professor of political economy at University of Lausanne, and lived in Switzerland until his death; named senator by Mussolini, but never took office ('The Mind and Society').

Par'go, the Spanish name for porgy. The members of the snapper family, including the muttonfish, important food fishes of the West Indies region, are also called pargos. See also in Index Porgy

Pargol, a gum from corn C-368 Parhe'lia. See in Index Sun Dogs

Pariah (pā'ri-ā), name used by Europeans for members of all the depressed classes, or "untouchables," of India; strictly, however, applied to only one of these classes: I-36-7

Pa'rian cement C-128 Parian marble M-61

Par'idae, a family of perching birds embracing the titmice, verdins, and bush-tits T-99–100

Pari'etal bone, the bone forming part of the side and roof of the cranium S-156, picture S-156

Parini (pä-rë'nē), Giuseppe (1729– 99), Italian poet, wrote criticisms of society in beautiful blank verse ('Il Giorno').

Paris (păr'is), Trojan warrior P-70,

Achilles slain by A-9 Hector and, picture H-268

Paris (pd-re'), Louis Philippe Albert d'Orleans, Comte de (1838-94), claimant to French throne, grand-son of King Louis Philippe; volunteered in Federal army, American Civil War, and served as captain on staff of General McClellan.

Paris (paris, French pa-re'), capital and largest city of France; pop. 2,880,000: P-71-5, map F-179 art galleries and museums, table M-392, 393. See also in Index

Louvre

books and bookmaking, medieval B-178, 180, 190

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salons, C-347a streets and boulevards P-71, 74

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Versailles near V-289

Paris, Tex., city 95 mi. n.e. of Dallas: pop. 18,678; large trade in cotton; cotton products and flour, furniture, iron foundry products; poultry packing: map T-56 Paris, Declaration of (1856). See in

Index Declaration of Paris

Paris, Pact of, or Kellogg-Briand Pact (Treaty for the Renunciation of War, 1928) C-354, A-247 signing, picture P-91

Paris, plaster of. See in Index Plaster of Paris

Paris, Treaties of 1763 (Seven Years' War) S-84, A-162

1783 (American Revolution) R-92: Jay and J-206

1856 (Crimean War) R-174 1898 (Spanish-American War) S-235 1928 (Pact of Paris) C-354

Paris, University of, one of the largest and oldest universities in the world; important in Middle Ages, gradually declined until abolished at French Revolution; reëstablished 1896; faculties of letters, science,

theology, law, medicine early postal system P-320 early years E-172, U-260: Abelard A-3

Paris Basin, region in France F-173 Paris green, a cupro-acetate of arsenic A-310, S-263

Par'ish, unit of government in Louisiana L-208

Parity, of farm prices A-57

Park, Mungo (1771-1806), Scottish explorer; followed the Niger River to the interior of Africa; drowned in attempt to escape from hostile natives on return trip.

natives on return trip.

Park, William Hallock (1863-1939), physician and public health worker, born New York City; organized in New York (1894) first municipal diagnostic laboratory in U. S.; directed it until 1937; noted for work in diphtheria and infantile paralysis; consulting bacteriologist for the state, 1914-39, and for U. S., 1921-39 (Tathogenic Microorganisms'; 'Public Health and Hygiene'). Hygiene').

Park College, at Parkville, Mo.; Presbyterian; founded 1875; liberal

arts, music.

Parker, Alton Brooks (1852-1926), American lawyer and Democratic leader, born Cortland, N.Y.; New York Supreme Court 1885-1904; de-feated by Theodore Roosevelt for presidency (1904).

Parker, Dorothy (born 1893), American writer, born West End, N. J.; on editorial staff of The New Yorker, 1927-29 and 1931; writes satirical and humorous verse ('Enough Rope'; 'Sunset Gun') and vivid short stories and sketches tinged with cynicism (Laments for the Living'); also motion picture scenarios and dialogue.

Parker, Francis Wayland (1837-1902) American educator, born Bedford, N.H.; rose to rank of colonel during Civil War; demonstrated marked ability as an educator; advanced the theories of Freebel and Restalogal which principal of Colon Pestalozzi while principal at Cook County (III.) Normal School (1883– 98) and Chicago Normal School (1896-99).

Parker, Sir Gilbert (1862-1932), British novelist, born in Canada P-75-6 Parker, Horatio William (1863-1919),

American composer, born Auburn-dale, Mass.; professor of music at Yale, 1894–1919; oratorio 'Hora Novissima' considered one of finest American compositions; also wrote operas ('Mona'; 'Fairyland'); compositions for orchestra, organ. piano; songs.

Parker, Louis N. (born 1852), English dramatist ('Pomander Walk'; 'Disraeli', played by George Arliss) Sherborne pageant P-11

Parker, Matthew (1504-75), archbishop of Canterbury (1559-75), born Norwich, England; chaplain to Anne Boleyn and to Henry VIII. Anne Boleyn and to Henry VIII; did much important work for the Church of England; had principal share in compiling 'Book of Com-mon Prayer'; opposed Puritanism book collecting B-188

Parker, Quanah (1845?-1911), Indian chief; son of Comanche leader and Cynthia Ann Parker, a white cap-tive. Refusing to settle on reser-vation, he and his band raided settlements on borders of Indian Territory (1867-74); after surren-der he developed farming and education among his people.

Parker, Theodore (1810-60), American rationalist preacher and social reformer, ardent abolitionist, born

Lexington, Mass.: C-249-50
Parkersburg, W. Va., city on Ohio
River, 75 mi. s.w, of Wheeling; pop.
30,103; oil and oil well supplies, iron and steel products, glassware, clothing; Blennerhassett Island near by: map W-76

Parkhurst, Charles Henry (1842–1933), American clergyman, born Framingham, Mass.; pastor Madison Square Presbyterian Church, New York City, 1880–1918; as president Society for Prevention of Crime, brought about investigation of New York, Police, CMY, Forty, Vacys, in York police ('My Forty Years in New York').

Parkin, Sir George Robert (1846– 1922), British educator, born Salis-bury, New Brunswick; advocate of imperial federation, organizer and secretary of Rhodes Scholarship Trust.

Parking, automobile A-392

Parkman, Francis (1823-93), American historian P-76, A-179 home in Boston B-200

Park Mountains, range in central Colorado.

Park Ridge, Ill., residential suburb 13 mi. n.w. of Chicago; pop. 12,063. Park Row, famous street in New York

City N-126
Parks. See also in Index Forest reserves; National Parks; Zoölogical

gardens cost and extent in U.S. L-93c national N-14-23

state and local N-22f zoölogical Z-219-26 zoriogical Z-219-26
Parlement (pūr-lū-mūn') of Parls,
supreme royal tribunal of France,
originating in medieval court;
through registration of laws exercised considerable influence over
king; abolished 1790
defles Louis XVI F-201
Parley, Pater. See in Index.

Parley, Peter. See in Index Good-rich, Samuel Griswold

Parliament (pär'li-ment), Australian A-373

building, picture A-376 Parliament, British P-77-9 buildings L-188, pictures P-77, L-183,

cabinet C-3 hat etiquette H-236 history P-77-8, 79

origin P-77, E-271: council becomes Parliament E-271; Simon Montfort M-249

montfort M-249
growth of power: Edward I E-188;
Edward III E-189-90; Richard II
R-104; Lancasters L-59, H-276
conflict: with James I J-182-3;
with Charles I C-147-9
Long Parliament P-79, C-149

Rump Parliament C-400-1, P-79, picture C-401 Whigs strengthen P-291

Bill of Rights (1689) B-109 authority over colonies R-84

Catholic disabilities removed 0-201 Reform Bill of 1832 E-275, P-78: Peel opposes P-100; Russell up-holds R-177; Wellington opposes

later electoral reforms P-78 power of Lords limited P-78, L-174 women admitted W-133 king's veto power P-79 members P-79

representation increased D-47, P-77 Parliament, Canadian C-62 Baldwin's work to establish B-16 buildings O-254, picture C-63 Parliament, French F-178-9 Estates-General E-304-5. F-201

Parliament, Houses of, London L-188, pictures L-183, 185, P-77

Parliament, Icelandic (Althing) I-6 Parliament, Irish (Dail) P-79, I-128,

Northern Ireland I-129 Parliament, Isle of Man M-49 Parliament, Japanese J-190

Parliament, Norwegian N-178, picture N-177 (Storthing) Parliament, Scottish P-79

Parliament, Swedish (Riksdag) S-338 Parliamentary government C-62-4 compared with congressional C-334

Parliamentary law P-79-81 constitution and its acceptance P-79

motions: making, seconding, voting P-80-1; classified, table P-80 points of order P-80

solnts of order 17-50 arlow (par'lō), Kathleen (born 1890), Canadlan violinist, born Calgary, Alberta; first appeared in public at age of six; later studied Parlow with Auer; one of finest of women violinists.

Parma (pär'mä), Italy, town 88 miles n.w. of Florence on the Parma River; pop. 72,000; cap. of province of Parma (1334 sq. mi., pop. 373,676); varied manufactures; valuable art collection which includes many paintings by Correggio, who lived here: map I-156

joins united Italy I-157; Bourbon rule ends (1860) B-207 Napoleon I annexes N-8

Parma, Ohio, residential and industrial village 9 mi. s.w. of Cleveland; pop. 16,365.

Parmenides (pär-měn'i-dēs), philosopher of 5th century B.C.; views set forth in a poem, 'Nature', part of which has been preserved.

Parmentier (pār-mānt-yā'), Antoine (1787-1813), French scientist promotes use of potato P-324

Parmesan (pär-mē-zăn') cheese C-165 Parnahyba (pär-nä-ö'bä) River, in Brazil, flowing into Atlantic Ocean; about 830 ml. long; map B-226

Parnassus (pär-năs'ŭs), Mount, modern Liakoura, in central 6 G-153, G-164, map G-154 Delphi, oracle of D-44, A-228 Deucalion's ark rests on D-58 Greece Parnell', Charles Stewart (1846-91), Trish political leader P-81-2

Par'nes, Mount, modern Ozea, Greece, 15 mi. n. of Athens; 4600 ft.: A-353

Parochial schools S-40

Parody, light or comic imitation of serious prose or poetry; origin attributed to ancient Greeks.

Parole (pa-rol'), of prisoners P-350 Paroquet (pār'ō-kēt), also parakeet, a bird belonging with the parrots to the family Psittacidae; body small with long tall; found in Mexico, South America, Centr America, Australia, Asia, Africa Carolina and Louisiana P-82 Central

Paros (pā'ros), Greek island of Cy-clades group in Aegean Sea just w. of Naxos; 96 sq. mi.; formed by Mt. Elias (2500 ft.); famous for pure white "Parian marble."

Parot'id gland, a large salivary gland situated in front of the ear P-206

Parr, Catherine (1512-48), 6th queen of Henry VIII of England; tactful, kindly woman to whose influence her step-children, the future sovereigns Edward VI, Mary, and Elizabeth, owed much: H-278

Parr, a young salmon S-13 Parrakeet. See in Index Paroquet
Parrant, Pierre, French-Canadian
trader, nicknamed "Pig's Eye";
first settler (1838) of St. Paul, first settler Minn.: S-11

arrhasius (pā-rā'shī-ūs), Greek painter of 4th century B.C., first master of correct drawing, and among first to use light and shade and realistic color to express round Parrhasius form; won contest with Zeuxis.

Parrington, Vernon Louis (1871–1929), English teacher and writer, born Aurora, Ill.; University of Washington, 1908–29 ('Main Currents in American Thought'; 'Single Control of the Contro clair Lewis-Our Own Diogenes').

Parrish, Anne (born 1888), American novelist, born Colorado Springs, noveist, norn Colorado Springs, Colo,; won Harper prize, 1925, with "The Perennial Bachelor' ("Tomor-row Morning"; 'All Kneeling'; 'The Methodist Faun'; also 'Floating Is-land', a story for children).

Parrish, Maxfield (born 1870), American painter, born Philadelphia; known especially for book illustrations ('Arabian Nights' and other classics) and murals; paintings are decorative and colorful.

Parrish, Randall (1858-1923), American author of adventure stories, born Henry County, Ill. ('When Wilderness Was King'; 'Beyond the Frontier').

Parrish, Stephen (1846-1938) ican artist, born Philadelphia, Pa.; father of Maxfield Parrish; particularly noted for his etchings of outdoor scenes.

Parris Island, S.C., an island at the mouth of Broad River in Beaufort County, s.e. South Carolina; both the French and the Spanish built forts here: S-214

Parrot, a tropical bird P-82, color plate P-83-4

care as pets P-156 cockatoo P-82, color plate B-130 dyeing with secretion of toad T-101 of life, average, pictograph A-198

macaw M-3

Parrot-fish, family of tropical food fishes (Scaridae), having semi-circular rows of fused teeth forming a parrot-like beak; many brightly colored: F-73, color plate O-200c-d

Parry, Sir Charles Hubert Hastings, (1848–1918), English composer; noted for series of choral works with orchestra ('Blest Pair of Si-rens', 'Invocations to Music'); pro-fessor of music at Oxford 1900–08; author of 'Studies of Great Composers' and 'Art of Music'.

Parry, Sir William Edward (1790-1855), English Arctic explorer; made three attempts to cross Northwest Passage; in 1827 tried to reach North Pole, attaining latitude 82° 45' N., which remained for 49 years the "farthest north" reached by explorers.

Parry Sound, Ontario, port on inlet of Georgian Bay; pop. 3512; sum-mer resort, with numerous islands; makes lumber and lumber products, chemicals, boats: map C-50c

Parsec, in astronomy, a unit of stellar distance equal to 3.26 light-years. Parsees (pär-sēz'), followers of Zoroaster in India; now chiefly in Bombay B-171, Z-231, picture I-38 sacred fires F-46

Parsifal (pär'sī-fāl), or Perceval, in Arthurian legend, innocent ignorant boy who becomes a knight-errant, withstands temptation, achieves the quest of the Holy Grail, thus delivering a stricken land and king; knight of the Round Table; father of Lohengrin; subject of opera by Wagner.

Parsley, an herb (Petroselinum hor-tense), the type plant of the parsley family

aromatic leaves S-249, 251

planting, directions for, chart G-13 Parsley family, or Umbelliferae, a family of herbs with small flowers in umbrella-shaped clusters; in-cludes carrot, celery, hemlock, parsley, and parsnip. See plants by name

Parsnip, garden plant of the pars-ley family P-85

when and how to plant G-13 Parsnip River, in e.-central British Columbia; flows n. 175 mi. and joins Finlay River to form Peace River.

Parsons, Sir Charles Algernon (1854-1931), British engineer and inventor, born London; inventions include Parsons compound steam turhine and a geared turbine; author of 'The Steam Engine'.

Parsons, William Barclay (1859-1932) American engineer, born New York City; designed first part of New York subway system; made surveys for Chinese railways; member Isthmian Canal commission and member of board of consulting engineers Panama Canal; chlef engi-neer Cape Cod Canal; in Spanish-

American and 1st World wars. Parsons, William Edward (1872– 1939), American architect and city planner, born Akron, Ohio; consulting architect to the U. S. government in the Philippines, 1905—14; made civic improvement plans for Chicago, St. Paul, Washington, D. C. and other American cities.

Parsons, Kan., city 125 mi. s.w. of Kansas City; pop. 14,294; trade center of agricultural region; packing plants, hatcheries, creameries, flour mills, railroad shops: map K-4

Parson's cause, lawsuit defended by Patrick Henry H-279

Parsons College, at Fairfield, Iowa; Presbyterian; founded 1875; liberal arts and sciences.

Parson's sermon, in 'Canterbury Tales'

Parsons turbine T-156

Parthenogen'esis, reproduction from unfertilized egg cells among insects I-86

Par'thenon, Athens A-11-12, A-355, A-260, E-331, pictures A-11, G-153, 152, color plate A-260a-b

Elgin marbles G-166, pioture G-161 frieze, pictures G-168, A-352, E-386, S-52

Illusion of straight lines I-19 meaning of name A-353 Phidias' work P-158

reproduction in Nashville, Tenn., picture N-12a sculptures S-53-4, ulptures S-53-4, G-166, pictu G-161, 168, A-352, S-52, E-336

Parthia (pär'thi-a), ancient country of Asia s.e. of Caspian Sea: most extensive sway under Mithridates I (174-136 B.C.): man R-130 Persia ruled by P-134 warfare, tactics A-307f

Partial tone, or overtone, in music S-197

Participating preferred stock S-290 Par'ticiple, in grammar V-282

Parties, political P-291-3. See also in Index Political parties Parties, social, etiquette E-312b

Partington, Mrs., English anecdotal character, said to have tried to mon up a tidal wave; used as pen name by Benjamin P. Shillaber (1814–90), American humorist.

Partisans. Revolutionary patriotic fighters in South Carolina S-216

"Partisans," term applied to guerrilla fighters, particularly those organ-ized by the Soviet government during 2d World War in Yugoslavia W-179f

Partition, in arithmetic, a method of division D-73-4

Partnership, an association of two or more persons in a business enterprise; they agree to share expenses, profits, and losses: E-148 corporation compared C-371

Partnership, in biology, association between two species for mutual

between two species for mutual benefit. See in Index Symbiosis Parton, Ethel (born 1862), author of children's books; born New York City; humorous stories in an historical setting: 'Tabitha Mary', a little girl of 1810; 'Vinny Applegay', New York in 1870.

Partridge, William Ordway 1930), American sculptor and author, born Paris, France; noted for busts of poets Longfellow, Tennyson, Burns, Whittier, and for monumental portraits (Shakespeare Lincoln Park, Chicago; equestrian statue of Grant, Brooklyn); author of 'Art for America'.

Partriuge, name given various birds of the family Perdicidae Q-1 bobwhite, or American quail Q-1 pictures Q-1, color plate B-134 ruffed grouse G-180-1

Partridge-berry, twin-berry, or squaw berry, a small trailing evergreen plant (Mitchella repens) of the madder family with shining dark green leaves, white pink-tinged fragrant flowers united in pairs, and scarlet berries in twos.

Parts, or voices, in musical composi-tion M-309-10, 312

Parts of speech G-127-8. See also in Index Adjective, etc.

Par value, or face value, of stocks and bonds S-290

Pasade'na, Calif., residential city and winter resort, 8 mi. n.e. of Los Angeles; pop. 81,864; founded 1882; citrus fruit packing and preserving, pottery; California Institute of

Technology, Pasadena College: maps C-26, 28 city hall, picture C-125 Mount Wilson Observatory, pic-tures O-194, T-39, 40 Rose Bowl F-148, 151a, d

Pasargadae (pā-sār'ga-dē), ancient cap. of Persia, said to have been built by Cyrus the Great on site of his great victory over Astyages (6th century B.C.); contained tomb of Cyrus.

Pascagou'la River, Miss., navigable stream 85 mi. long formed by junc-tion of Chickasawhay and Leaf

rivers: map M-200

Pascal (pás-kál'), Blaise (1623-62) French philosopher, mathematician, and physicist ("Thoughts'; 'Pro-vincial Letters', best example of "polite, controversial irony" since

ealculating machine C-20 law of fluid pressure H-368

Pascal, Jean Louis (1837–1920), French architect, born Paris; exercised wide influence; designed memorials to Hugo, Carnot, and Michelet, and many important public buildings and houses

Pasein (pās'kēn'), Jules (1885–1930), American artist, born Bulgaria; traveled extensively, painting peo-ples; depicted life of Negro of Cuba and southern United States; noted for figure studies and for satirical drawings of underworld.

Pasha (på-shë' or päsh'à), former Turkish title of nobility, higher in rank than that of bey; first given only to military officers, later be-stowed also on civil officials or private citizens; abolished 1934.

Pasha, famous diamond, picture D-63

Pasha butterfly (Charaxes jasius), European species of a genus of butterflies found in African and Indian regions; expanse of wings, about 3 in.; color brown, orange, blue, and black; flight rapid and high

caterpillar, picture C-98 Caterphine, picture C-98
Pashitch (pāsh'īch), or Pasic, Nicholas (1846?-1926), Serbian statesman; prime minister during 1st
World War; largely responsible for
establishment of kingdom of Yugo-

Pasig (pä'sīġ) River, Philippines, short river in s. end of Luzon M-53 Pasin, a garment worn in Thailand T-73b

Paspalum (păs'pā-lum). See in Index Dallis grass

Pasque (pask) flower, of the anemone family, named from old French word for Easter, its time of bloom-

ing A-195-6

Passa'ic, N. J., manufacturing and residential city 13 mi. n.w. of New York City, on Passaic River; pop. 61,394; textiles, rubber, dyes, chemicals; several engagements in Revolutionary War: map N-90

Passaic River, in n.e. New Jersey, emptying into Newark Bay; immense water power; about 100 mi.

falls at Paterson P-88

Passamaquod'dy, division of the Ab-naki group, of Algonquian stock; lived in Canada and Maine.

Pass'ant, in heraldry H-281 Passau (pit'sou), old town of Bavaria, Germany, at junction of Danube, Inn. and Ilse, 90 mi. n.e. of Munich; pop. 25,000; Treaty of Passau (1552) granted religious freedom to Lutherans: map G-66

height 6 mi, n.e. of Ypres 1st World War battles W-161

Pass Christian (pas kris-ti-an'), Miss., town and winter resort 70 mi. due s. of Hattiesburg on Gulf of Mexico; pop. 3338: map M-200

Passenger pigeon P-215, B-145a Passeriformes (pas-er-i-for mes), the order of perching birds B-132, color plates B-137, 138, 139, 140

Passfield, Baron. See in Index Webb,

Passion flower, or maypop P-85 pollen grain, picture F-125

Passion-flower family, or Passiflora-ceae (păs-i-flō-rā'sē-ē), a family of plants and woody vines, including the passion-flower, maypop, granadillas, and Jamaica-honeysuckle.

Passionists (Congregation of the Discalced Clerks of the Most Holy Cross and Passion of our Lord Jesus Christ), religious order founded in Italy 1720 vows M-236

Passion Play, dramatic representa-tion of sufferings of Christ; most famous one given periodically by villagers of Oberanmergau, Ba-varia, since 17th century in grati-tude for cessation of plague of 1633: B-65

Passion Sunday E-140 Passion Week E-140

Passive voice, of verb V-282 to be avoided in writing W-189 Passos, John Dos. See in Index Dos

Passos, John Passover, a Jewish festival in honor

of the night when the Lord, smit-ing the first-born of the Egyptians, "passed over" the houses in which the children of Israel lived: P-85 Passport P-85-6

Passump'sic River, in n.e. Vermont; tributary of the Connecticut: map

N-86

Passy (pa-se'), a part of Paris in the western section of the city, adjoining the Bois de Boulogne.

Paste, or strass, a glass used in imitation gems G-26

Pastel (pās-tēl'), a sort of crayon made by mixing chalk with color-ing pigment by the use of an adhesive; term also applies to drawing (portrait, still life, landscape) in which this crayon is used.

Pasternak (püs-tër-näk'), Boris Leon-idovich (born 1890), Russian poet ('My Sister'; 'Life').

Pasteur (pås-tûr'), Louis (1822-95), French chemist and bacteriologist,

P-86, picture P-87 germ theory of disease P-86: antiseptics A-222 humility H-355

Lille university professor L-136 tartrates, study of T-14

Pasteuriza'tion of milk P-86, D-5

Pasto (päs'tő), Colombia, city in s.w.; pop. 55,000; wool, pottery, wooden bowls: map C-305 Pastoral life. See in Index Nomadic

life and peoples

Pasteral poetry, poetry dealing with country life (from Latin pastor, shepherd); applied especially to poems in which the characters are poems in which the characters are represented as shepherds and shep-herdesses in a highly idealized setting. Derived from the Greeks and Romans, pastoral poetry be-came very popular in England in the 16th century with the work of Sidney, Spenser, Drayton, and Herrick.

Passchendaele (päs'ken-dä-lů) Ridge, Pasto'rius, Francis Daniel (1651-

1719), German-American colonist; of strong character and wide learning; had great influence upon colonists: P-116

Pasture, Roger de la. See in Index Weyden, Roger van der

Pasture lands, or grazing lands G-137, D-113c, L-61b proportion in U. S., map L-61a, graph L-61b

Taylor Grazing Act, U. S. L-61c Pat, native name for jute J-232

Patago'nia, a region in South America A-280a, b, S-208h, maps A-279, S-208c, d Andes Mountains A-195

Magellan's captive M-28 name, meaning S-2060 native superstition M-29-30 sheep ranch, picture A-280a Patagonian rabbit H-223

Patapsco (pä-täps'kö) River, in n. Maryland, 80 mi. long; enters Chesapeake Bay 14 mi. below Baltimore: B-33, map M-78

Patching, in sewing S-90-1

Patchouli, or patchouly (pa-chg'li), dried branches of the East Indian patchouli plant Pogostemon patchouli or Pogostemon heyneanus of the mint family, having an extremely strong odor; used to protect woolens from moths, in manufacturing perfume. fancy tobacco.

Patchwork quilt, colonial A-173, pic-ture A-165

Pâté de foie gras (pä-tā' dǔ fwä 引rä) G-119

Patella, the knee cap, a flat circular bone, picture S-156

Patent flour F-118, 119

Patent leather how prepared L-85

manufacturing center, Newark N-80 use of ultra-violet rays R-15

Patent medicine, a medicine the manufacture of which is protected by letters patent, an official document giving the manufacturer the right to make and distribute the medicine advertising A-24, 24a

Patent Office, U. S. P-86, 88, picture II-227

trade marks C-362 Patents P-86, 88

automobile cross-licensing A-390 plants, new varieties P-245e pool, automobile example A-390 shoe industry affected by S-132 trade-marks compared with C-362

Pater (pātēr), Walter (1839-94), English essayist, refined and subtle stylist ('Martus the Epleurean'; 'Imaginary Portralts'; 'Plato and Platonism').

Pater Noster (pā'tēr nos'tēr), Latin name for Lord's Prayer.

Paterson, Andrew Barton (1864-1942), Australian poet and short-story writer A-376

writer A-376 aterson, John (1744–1808), American soldier and public official, born Wethersfield, Conn.; became major general in Revolutionary war; later as resident of Broome County, N. Y., served in legislature (1792–93) and in Congress Paterson. (1803-5)

Paterson, William (1658-1719), Scottish financier, founder of the Bank of England; promoter of a disastrous attempt to colonize Darien (Panama) in 1698.

Paterson, William (1745-1806), American statesman and jurist, born Ireland; attorney general of New Jersey; member of Constitutional Convention; U. S. senator; governor of New Jersey; associate jus-

tice Supreme Court; Paterson, N.J., named for him.

Paterson, N.J., chief silk-manufac-turing city of United States; pop-189,656: P-88, map N-90

Pathan (pā'thán), name sometimes applied to certain tribes living in Afghanistan and India A-29

'Pathétique', symphony by Tschaikovsky M-315

Pathfinder, in Cooper's novel 'The Pathfinder', nickname of Natty Bumppo, the hero.
Pathfinder Reservoir, Neb. N-58
Pathfinder Reservoir, Neb. N-58

Pathol'ogy, science dealing with dis-ease M-108. See also in Index Disease: Germ theory of disease; Plant diseases

plant B-203

'Patient Griselda', in 'Car Tales' C-162, pioture C-162 in 'Canterbury

Patio (pä'tē-ō), inner court of a Spanish or Spanish-American dwelling S-205, S-85, L-67j New Orleans, picture N-101

Pat'more, Coventry Kersey Dighton (1823-96). English poet and critic, member of Pre-Raphaelite group; produced some beautiful verse; paid particular attention to mechanics of poetry ('The Angel in the House'; 'The Unknown Eros'; 'Amelia').

Pat'mos, bare volcanic island, one of the Sporades in Aegean Sea; here St. John lived for 18 months in exile and here he is said to have written

the Apocalypse.

Patna (pät'nä), British India, com-mercial center, cap. of Bihar Prov-ince, on Ganges River 285 mi. n.w. of Calcutta; pop. 160,000; opium, indigo; university (founded 1917); massacre of Patna 1768, and Sepoy Mutiny 1857: maps I-30, A-332c

Patras (pë/träs), Greece, fortified sea-port and trade center on w. coast on Gulf of Patras; pop. 60,000; one of 12 Achaean cities; early center of Christianity; cradle of Greek revolution 1821: map B-18

Patri (päitrē), Angelo (born 1877),
American author and educator,
born in Italy; educated in New
York; specialist in child training
('A School Master of the Great
City', 'Pinocchio in Africa'; 'Pinocchio in America').

Patriarch (pā'tri-ārk) (from Greek meaning "father" and "rule"), meaning "father" and "rule"), father and ruler of a family or tribe; in Biblical history applied particularly to Abraham, Isaac, and Jacob; in Roman Catholic church term used to signify a bishop of the highest rank, and in Greek church a high dignitary, such as the patri-arch of Constantinople.

Patriarchate, a society in which the father rules F-8

among Bedouins F-10

Patricia (på-trish'à), Princess. See in Index Ramsay, Lady Patricia Patricians, aristocratic class of Rome

Pat'rick, Saint (389?-461), apostle to Treland and its patron saint P-88-9 Ireland in time of I-126, I-132 monastic training M-233 shamrock S-101

Patrick, Order of Saint D-35 Patrick Henry National Monument Project, in Virginia N-220 Patriot'ie societies, U.S. P-89 Patriotic songs N-24-7

Patriotism in modern civilization C-248 Kipling's K-24
parable of ("The Man Without a
Country") H-199 Patriots' Day (April 19) H-320 Patroclus (pā-trō'khūs), in Greek my-thology, hero of Trojan War, friend of Achilles A-8

Hector kills H-269 Patrol airplanes, U. S. Navy N-53,

Patrolman, of police force P-287 Patrons of Husbandry. See in Index Grange, National

Patronym'ics ("father-names"), origin of N-2-3

Patroon', landed proprietor in Dutch colonies in America N-121, A-156

Patterns, for sewing S-88, 89, 92 Patterson, A. B. (born 1864), Aus-

tralian poet A-376 Patterson, Elizabeth (1785-1879), first wife of Jérôme Bonaparte B-172

Patterson, Walter (died 1798), British soldier, born Ireland; governor in chief Prince Edward Island 1769-84 and lieutenant governor 1784-87.

Patti (pát'i), Adelina, Baroness Cedar-ström (1843-1919), operatic so-prano celebrated in many countries her wonderfully pure voice, which kept its freshness even in her later years; made début as "Lucia" in New York City at 16; last appeared in U.S. 1911: picture O-232

peared in U.S. 1911: picture O-232
Pattle, James Ohio (1804-50?), trapper and explorer, born Bracken County, Ky.; took part in trapping expeditions along Colorado and Yellowstone rivers (1826-28), the last expedition ending in s. California where the party was imprisoned; returned to Cincinnati 1830 and published 'Personal Narrative', an exagrerated and unrative', an exaggerated and untrustworthy account of his experiences

Patton, George S. (born 1885), U. S. Army officer, born San Gabriel, Calif.; aide to Pershing in Mexico 1916; tank expert in 1st World Usin, Fort Benning, Ga. 1940-41; commander 2d Army Corps, North Africa at Casablanca and in Tunicia 104, 42; med commander of sia 1942-43; made commander of 7th Army invading Sicily July 1943.

Pau (pō), winter health resort of s.w. France 55 mi. s.e. of Bayonne; pop. 40,000; ancient capital of Navarre; chateau (1360) was chief residence of sovereigns of Navarre and birth-

place of Henry IV.

Paul, Saint (died about 67 A.D.), "the Apostle of the Gentiles," first great Christian missionary (name originally Saul); festival with that of St. Peter, June 29: P-90, C-231. See also in Index Paul, Epistles of

Athens A-355 concept of society S-184 converted at Damascus D-9 Corinth C-364

Rome P-90

Paul I, pope 757-767; received aid of Frankish king, Pepin I, against Lombards and Byzantine emperor.

Paul II (Pietro Barbo) (1417-71), pope, elected 1464; made severe laws against paganism of the Renaissance, but was friendly to scholars; collected works of art.

Paul III (Alexander Farnese) (1468– 1549), pope, elected 1534; excom-municated Henry VIII of England; commissioned Michelangelo to paint the 'Last Judgment'

Inquisition commission established I-80

Paul IV (Giovanni Pietro (1478-1559), pope, elected 1555; opposed Reformation and made breach between churches of England and Rome impassable.

Paul V (Camillo Borghese) 1621), pope, elected 1605; of fa-mous Borghese family; violent dis-putes with Venice and other Italian states over rights of the clergy; began Villa Borghese; added to Vatican library and collected antiquities.

Paul I (1754-1801), czar of Russia; succeeded his mother, Catherine II, in 1796; cruel despot and madman;

assassinated by nobles. Paul, Alice (born 1885), woman suffragist, born Moorestown, N.J.; imprisoned three times in England and three times in U.S. for activities in woman suffrage movement: W-133

Paul, Elliot H. (born 1891), author and journalist, born Malden, Mass.; after service in 1st World War did newspaper work in Paris; author of impressionistic novels 'Indelible', impressionistic novels 'Indelible', 'Imperturbe', and 'Impromptu' and of mystery novels. His life (1931or mystery novels. His life (1931-36) in Santa Eulalia, a Balearic island village, was basis of book, 'The Life and Death of a Spanish Town'. 'The Last Time I Saw Paris' (1942) is an account of life on a side street in Paris.

aul, Jean. See in Index Richter, Johann Paul Friedrich

Paul, Lewis (died 1759), inventor of and, Lewis (ded 1759), inventor of spinning machinery; took out patent for "roller-spinning" (1738), having had mechanical and finan-cial assistance from John Wyatt; patented a carding machine (1748), spinning machine (1758): I-740

Paul. Epistles of, books in New Testament comprising 13 letters by Apostle Paul-Romans, I and II Corinthians, Galatians, Ephesians, Philippians, Colossians, I and II Thes-salonians, I and II Timothy, Titus, and Philemon (Hebrews sometimes included); P-90 Galatians C-124

Thessalonians S-14

Paul and Virginia', pastoral romance by Bernardin de St. Pierre concerning two children brought up to-gether in tropical Mauritius in idyl-lic simplicity, untouched by customs of the outside world; subject of operas and plays.

Paulding, Hiram (1797-1878), U.S. admiral; burned Norfolk Navy Yard April 1861 to prevent its fall-

ing to Confederates.

ning to Confederates.

Paulding, James K. (1778-1860),

American author and naval official,
born in what is now Putnam
County, N. Y.; friend of Washington Irving; best novels about Dutch
life, but satirical writings in reply
to British criticism of the U. S. won
him navy posts, finally the secretaryship 1837.

Paulhan (nol-dh'), Louis, early

aulhan (pôl-àn'), Louis, early French aviator; in 1910 flew from London to Manchester with only Paulhan one stop, also made altitude record:

ploture A-70

Paulinus of Nola, Saint (353-431), bishop and writer, born Bordeaux, France; son of wealthy Roman official; devoted life and riches to charity: L-104

Paulist Fathers, Catholic religious or-der, properly called the "Congre-gation of Missionary Priests of St. Paul the Apostle"; founded in New York by Father Isaac Thomas Hecker in 1858 for missionary work

among non-Catholics in America.

Paull, Grace (born 1898), American
artist and illustrator of children's
books; born Cold Brook, N.Y.

Paulmy, Marc Antoine René de Voyer, Marquis de (1722-87), French lawyer and book collector; born at

Valenciennes; assembled one of the largest private libraries on record. T...105

Paul of Thebes (3d century), a hermit M-232

M-232
Paulownia (p6-lō'mi-a). small group of trees native to China but cultivated in warmer parts of U.S. One species, royal paulownia, grows 25 ft. to 40 ft. Leaves heart-shaped, to 1 ft. long; flowers pale violet with purple spots in throat, fragrant, in loose clusters 1 ft. long.

'Paul Revere's Ride', poem by Long-fellow. See Revere, Paul

Paulus, Lucius Aemilius (228-160 B.C.). Roman general who destroyed Macedonia: L-103

Paulus Hook, site of Jersey City J-211 Paul Veronese. See in Index Veronese. Paul

(pans'fōt), Julian, first 828-1902), English dip-Pouncafota Baron (1828–1902), English dip-lomat; held colonial posts in Hong Kong and British Leeward Islands: British ambassador to Washington; secured arbitration of Bering Sea secured arbitration of Bering Sea seal fishery dispute, and brought about a revision of the Clayton-Bul-wer Treaty regarding the Panama Canal. See also in Index Hay-Pauncefote Treaty

Paunch, or rumen, a part o stomach of a ruminant R-176 Pauperism, relief of P-302-3

Pauperism, reflet of P-302-3

Pausanias (pa-sā'm-ās) (5th century
B.C.), Spartan general and regent;
led Greek forces to victory at
Plataea 479 B.C.; ambition then
made him a traitor; died walled up
in temple where he had taken refuge, his mother bringing the first

Pausanias (2d century A.D.), traveler, geographer, and writer on art

visits Acropolis A-12

Pavement teeth, in shark S-102

Pavement teeth, in snark S-102

Pavia (pä-vē'ä) (ancient Ticinum),
city of n. Italy 18 mi, s. of Milan
on Ticino River; pop. 50,000; university; cap. of Lombard kingdom;
taken by Charlemagne 774; here
Charles V defeated and took Francis I of France prisoner (1525).

Paving machine, picture R-112

Paving materials R-115-16 asphalt A-337, R-115 brick C-261, R-116

Paviotso (pä-vē-ōt'sō), a group of Shoshonean Indians, living in the deserts of s.w. Nevada and s.e. California I-54

Pavlov (päv'löf), Ivan Petrovich (1849-1936), Russian physiologist; noted for researches on digestion and on functioning of the brain (conditioned reflexes); received Nobel prize in medicine, 1904; director physiological department, Institute of Tanana (1904). Institute of Experimental Medicine, Leningrad, 1891-1996, also professor at Military Medical Academy, Leningrad, 1897-1924: R-64

Pavlowa (päv'lō-và), Anna (1885-1931), famous Russian dancer, born St. Petersburg (Leningrad); trained for Imperial Russian ballet from childhood; prima ballerina at 16; created unique dances in classical ballet style ("The Swan'; 'Chop-iniana'; 'Autumn Bacchanal').

Paweatuck River, R.I., forms part of boundary between Connecticut and

Rhode Island, map R-97
Pawhuska, Okla., city 43 mi. n.w. of
Tulsa; pop. 5448; farming, livestock
raising; gas and oil fields; Osage

Indian Agency and Osage Indian Museum; once capital of the Osage nation

Pawn, betel nut preparation B-101 Pawn, in chess C-182-4

Pawne (pa-në'), tribe of Plains Indians of Caddoan stock, formerly roving about Nebraska in Platte River valley: I-54 houses I-59, 60 moved to Indian Territory O-220

"Pawnee Bill." See in Index Lillie, Gordon W.

Pawpaw. See in Index Papaw

Pawtuck'et, R. I., city 4 mi. n. of Providence; pop. 75,797; textiles, foundry products, machinery: map R-97, pioture R-96 first cotton mill in U. S. R-95

Pawtux'et River, R. I., flows into Narragansett Bay, map R-97 Pax Romana, "Roman peace" R-134-5

Pay-as-you-go tax plan N-12a Payette, Francis, Idaho pioneer and fur trader I-10

Payne, David L. (1836-84), American soldier and pioneer, born Indiana Oklahoma homesteader O-220

Payne, John (1842–1916), English poet and translator; work shows influence of Pre-Raphaelite school; translations of Villon's 'Poems', Boccaccio's 'Decameron' 'Arabian Nights' A-244

Payne, John Howard (1791-1852). American actor and dramatist, born New York City; had great success on stage in England and America; remembered as author of "Home, Sweet Home," first sung in his opera 'Clari, or the Maid of Milan'; wrote or adapted many plays; U. S. counsul at Tunis, where he died

reproduction of home, picture G-94 Payne, Roger (1739-97), famous English bookbinder B-183

Payne, Sereno Elisha (1848-1914), American lawyer and political lead-er, born Hamilton, N.Y.; served in national House of Representatives almost continuously from 1888 until his death; one of the framers of the Payne-Aldrich Tariff Act.

Payne-Aldrich tariff T-2 Payne Lake, in n. Quebec; 475 sq. mi.;

outlet, Payne R.: map C-58 Paysandú (pi-sán-da'), Uruguay, city on Uruguay River, about 220 mi. n. w. of Montevideo; pop. 50,000; commerce in cattle, corn, wheat, and fruit; meat preserving, tanning, shoes, soap: map U-262
P. D., potential difference in electricity E-220, 222

Pea, a climbing pod-bearing plant or its seed P-90

color inheritance, piotograph H-283a food value P-90, pioture M-172 nitrogen gatherer N-147 planting, directions for, table G-13 structure S-75

Pea, sweet S-341 planting G-7

Peabody, Elizabeth Palmer (1804-94), abody, Elizabeth Falmer (1804-94), educator and writer, born Billerica, Mass.; sister-in-law of Nathaniel Hawthorne and Horace Mann; studied Greek under Emerson, taught under Amos Bronson Alcott: introduced Froebel's methods in first distinctly American kindergarten in Boston in 1860.

Peabody, George (1795-1869), American banker and merchant P-90-1

Peabody, Mass., industrial city 2 ml. w. of Salem; pop. 21,711; plain and morocco leather manufactures, tan-ning machinery, shoes; Peabody Institute; incorporated 1855 as

South Danvers: name changed 1868 in honor of George Peabody.

Penbody College. See in Index George Penbody College for Teachers Peabody Fund, for education P-90-1 Peabody Institute, Baltimore P-91
Peabody Museum of American Ar-

cheology and Ethnology, table M-393 Peace, or Neutrality, Act (1937) N-75b Peace Bridge, from Buffalo, N.Y., to Fort Erie, Canada B-261

Peace Conference of 1919 W-173-4, chart H-304. See also in Index World War, First, subhead Peace world war, Frist, subtett Feace settlement and territorial changes "Big Four," picture U-249
Borden B-195

Clemenceau C-263 Lloyd George L-175 plenary session, picture W-175 Smuts S-166 Venizelos V-280 Versailles scene of V-289 Wilson W-110-11

Peace conferences, Hague H-195. See also Hague Peace conferences
Peace Day (May 18) H-320

Peace may (May 1) 11-320
Peace movement P-91-2. See also in Index Armaments, Limitation of Addams, Jane, activities A-17 arbitration A-246-7
Briand's efforts B-235
Bryan's efforts B-255 Carnegie's contributions C-86, H-194 Hague Peace conferences H-195 Kellogg-Briand treaty A-247, C-354 League of Nations L-77-8 neutral nations, efforts in 2d World War W-178f

Nobel prize winners N-148, 149 Peace Day H-920 Taft's efforts T-3-4 World Court L-78

Peace Palace, at The Hague, picture TT_194

Peace plans, 2d World War W-179g-180

Peace River, in n.w. Canada P-92-3, man C-50b

"Peace without victory" W-168 Peach P-93 classification P-93, F-214 cyanogen in pits C-419 Michigan orchard, picture M-150 original home in Asia A-332

pests I-89 Peach Blossom Festival, or Dolls' Festival, in Japan J-194

Peach moth, oriental, a lepidopterous insect (Laspeyresia molesta) I-89 Peach Tree Creek, indecisive Civil War battle fought near Atlanta, Ga., July 20, 1864, between Federals under General Sherman and Con-federates under General Hood.

Peacock, Thomas Love (1785–1866), English satirical novelist and poet, friend of Shelley ('Nightmare Abbey'; 'Crotchet Castle').

Peacock P-93-4 English Christmas ceremony C-229 iridescent feathers F-21 myth P-94

'Peacock', British sloop-of-war captured by Lawrence L-74

Peacock butterfly, a genus including the buckeye, color plate N-38a-b

Peacock Throne, seized at Delhi in 1789 by Nadir Shah D-43 Pea-crab C-388

Pea family. See in Index Legumes Peahen, a female peafowl P-93

Peak, The, or High Peak, in Derbyshire, England; 2086 ft.; at south-ern end of Pennine chain; proposed as a national park.

Peak load, in electric power service E-235, 237

Peale, Charles Willson (1741-1827) American portrait painter, one of the most eminent of colonial times, born Chestertown, Md.; captain in Revolutionary War; one of the founders of the Pennsylvania Academy of Fine Arts; portraits of prominent people include Washington (who sat for him 14 times), Washington, Martha Greene Franklin, Jefferson, Jackson, and Clay.

Peale, Rembrandt (1778-1860), American portrait and historical painter, son of Charles W. Peale, born Bucks County, Pa.; portraits of Washington, Gilbert Stuart, Jefferson ('The Court of Death') portrait of Washington, picture W-21

Washington memorial design, picture B-33

Peanut, groundnut, earthnut, or goober P-94-5, N-187 China C-221a

oil P-94 products from P-2450, P-94 protein content P-94 Virginia V-304, picture V-305 Pear P-95

Pear, alligator F-212 Pear, prickly C-10, 11
Burbank's "thornless," picture B-277

Pea Ridge, Civil War battle fought at Pea Ridge (Ozark Mts.) in n.w. Arkansas, March 7-8, 1862; first victory of Union troops w. of Mississippi; saved Missouri to Union

Pearl, Raymond (1879-1940), Ameriearl, Raymond (1879–1940), American biologist and statistician, born Farmington, N. H.; connected with National Research Council 1916–35; chief of statistical division, U. S. Food Administration 1917–19; at Johns Hopkins University—director, Institute of Biological Research 1925–30, and professor of biology 1930–40; noted for research in questions of heredity, population, and tions of heredity, population, and length of life

biometry applied to growth of populations B-119

Pearl, Mother of, or nacre S-107, P-97 obtained from abalone S-108

Pearl barley B-47

Pearl buttons B-287, S-108

Pearl Harbor, U. S. naval base in Hawaiian Islands H-240-1, N-52, maps H-242, N-52 Japanese attack H-241, W-178v, pio-

ture W-178w

Pearl Mosque, in Delhi D-43 Pearl of the Orient, Ceylon C-137

Pearl River, or Chukiang, China. See in Index Canton River

Pearl River, Miss., stream 850 mi. long, forming part of e. boundary, maps M-200, L-206

Pearls P-96-7, color plate G-27a-b cultured and imitation P-97

oyster, pictures P-97, O-265
where found P-97; Ceylon C-137;
Lower California P-97; Mississippi
River I-122; Persian Gulf P-134

Pearl sago S-4 Pearl tapioca T-10 Pearl type T-172

Pearly nautilus, a mollusk N-44, pio-tures N-44, S-109

Pearson, Karl (1857-1936). English mathematician; emeritus professor of eugenics, University of London ('Grammar of Science'; 'Life and Letters of Francis Galton'; 'Tables for Statisticians'; editor of Bio-metrica and of Annals of Eugenics).

Pearson, Weetman Dickinson. See in Index Cowdray

Josephine Diebitsch, Arctic er and writer, born Washtraveler and writer, born Washington, D. C.; married Robert E. mgton, 18.8; accompanied him on expeditions (1891-94); interpreter of arctic life for young children ('Snow Baby'; 'Children of the Arctic'): P-98

Peary (pë'ri), Robert Edwin, Rear Admiral (1856-1920), discoverer of North Pole P-97-8, pictures

P-98, P-282 grave U-225

voyages P-98, maps A-277, G-176 Peasants' Revolt, in Canada (1837) P-61, Q-5

Peasants' Revolt, in England, or Wat Tyler's Rebellion (1381) T-171-2 Richard II and R-104 Wyclif and W-191

Peasants' Revolt, in Germany (1525) G-72, R-65-6

Pease, Elisha M. (1812-83), American lawyer, born Enfield, Conn.; set-tled in Texas to study law just before outbreak of revolt against Mexico; served Republic of Texas in many capacities, and later was twice governor of the state (1855-59, 1867-69).

case, Howard (born 1894), author of sea stories for boys; born Stock-ton, Calif. ('Tattooed Man'; 'Jinx Ship'; 'Long Wharf'; 'High Road to Adventure').

Peat, partly carbonized vegetable material P-98-9 carbon cycle, pictograph P-238a changed to coal C-283 fuel value F-215

Minnesota M-190 moss forms M-272

Peattie, Donald Culross (born 1898), American botanist and author, born Chicago, Ill. ('Almanac for Mod-Chicago, Ill. ('Almanac for Moderns', exquisite short essays on various aspects of nature; 'Singing in the Wilderness', lyrical blography of Audubon; 'Green Laurels', short lives of great naturalists').

Peau de sole (pô dữ swä') (French "skin of silk"), a strong, firm silk fabric with satiny surface on one or both sides.

Pebble mill, for grinding clay for pot-tery P-327, picture P-329

Pebbles, small stones

how formed, picture N-30 Pecan', a nut-bearing tree P-99-100 Pec'cary, or muskhog, small wild hog of North and South America P-100, S-208i, picture H-316 foot, picture F-147

Pechenga. See in Index Petsamo

Pechora River, in n. Russia, rising in Ural Mts. and flowing 970 mi. to n. coast: map E-326e

Pechsteln (pěw'stin), Hermann Max (born 1881), German expressionist painter; technique influenced by Matisse; work shows strength and dramatic power, fine drafts-manship ('Drowned Fisherman'; 'Double Portrait').

eck, Anne Merriman (born 1884), artist and author of travel books, born Piermont, N.Y.; for adults: 'Vagabond's Provence', 'France, Crossroads of Europe', 'for chil-dren: 'Roundabout Europe', 'Young Maylog', 'Snein in Europe and Mexico', America'. in Europe and 'Spain

Peck, Samuel Minturn (1854-1938). American poet and novelist, born Tuscaloosa, Ala.; wrote chiefly about the South ('Rhymes and about the South ('Rhymes and Roses'; 'Rings and Loveknots'; 'Fair Women of Today', poems; 'Alabama Sketches', short stories). Peck, unit of dry measure, table W-67 Pecksniff, Seth, in Dickens' 'Martin Chuzzlewit', a canting hypocrite.

Pecos (pā'kōs) River, chief tribu-tary of Rio Grande; rises in New Mexico at base of Baldy Peak; flows s. and s.e. 800 ml., entering Rio Grande on Texas-Mexican border: maps N-97, T-56 canyon at Del Rio R-109

irrigation of valley N-97

Pecos Trail C-112

66s (pch), Hungary, formerly Fünfkirchen, town 105 mi. s.w. of Budapest; pop. 41,000; fine medi-eval cathedral; makes woolens, leather, paper, porcelain; surrounding vineyards produce famous wine: map A-381

Pectin, the chemical substance in

fleshy fruits and in some vegetable roots which causes them to jelly or solidify upon being boiled; commercial pectin produced from fruit juices with high pectin content colloidal effect C-303

Pec'toral muscle, picture M-304

Pedagogues, in ancient Greece E-168 Pedagogy (pēd'a-gō-ji), the art or science of teaching. See in Index Education

Ped'alfer, soil S-191b, map S-191c Pedals, in musical instruments harp H-225 organ O-250

Pedersen, Christiern (1480?-1554), "Father of Danish literature"; his translation of the Bible, called 'Christian III's Bible, is landmark in Scandinavian literature.

Pedersen, V., Danish illustrator L-160 Pedestrians, safety rules for S-2g-h, j Pedicel (ped'i-sel), of spider S-258 Pedigreed stock C-104

piano P-211

Ped'iment, in classic architecture, tri-angular-shaped portion of wall above the cornice, corresponding to gable in Gothic architecture Parthenon sculptures A-11, color

plate A-260a-b

Ped'ipalp, of spider S-258

Ped'ocal, soil S-191b, map S-191c Pedom'eter, a watch-shaped instrument worn on the body and fitted with an oscillating weight which is affected by the motion of the body and thus records the number of and thus records the number of steps taken; from this can be deter-mined the distance covered.

Pedro I (1798-1834), emperor of Bra-zil, son of John VI of Portugal, commed 1822; succeeded to Portugal, crowned 1822; succeeded to Portuguese crown 1826; resigned it to daughter Maria da Gloria; abdicated Brazilian crown 1831; died after restoring his daughter to Portuguese through 18-28 Portuguese throne: B-228

Pedro II (1825-91), emperor of Bra-zil; succeeded 1831; compelled to abdicate 1889; prosperous reign notable for emancipation of slaves and war (1864-70) with Paraguay.

'edro (pē'drō, Spanish pā'drō) III (1236-86), king of Aragon; called "the Great" because of success in conquering Sicily chosen king of Sicily S-140

Pedro I, the Cruel (1833-69), king of Castile and Leon; succeeded 1850; provoked rebellion of his

brother Henry, by whom he was killed.

Pedro V (1887-61), king of Portugal; succeeded 1853; reign marked by freedom from civil strife and by economic improvement.

Pee Dee (pē'dē) River, in South Carolina, continuation of the Yadkin,

of North Carolina; Little Pee Dee River is a tributary: map S-213

"Peek-a-boo," game P-256

Peek'skill, N. Y., port on Hudson River 40 mi. n. of New York City; pop. 17,311; leather goods, clothing, oilyeast; marble and granite es; several preparatory cloth. quarries; schools: map N-114

Peel, Sir Robert (1788-1850), British statesman P-100

anecdote C-383-4

catholic Emancipation Act O-201 corn laws, repeal P-100: Disraeli on D-71; Gladstone supports G-98 police system P-287, P-100 Peel, in bakery oven B-232

Peele, George (1558?-98?), English dramatist and poet; with Marlowe and Greene influenced English literature through Shakespeare, who borrowed from them ('The Old borrowed from them ('The Old Wives' Tale'; 'The Arraignment of Paris'; 'The Love of King David and Fair Bethsabe').

"Peeler," English police P-100

Peep, small U. S. Army car, similar to jeep but has only one-half its capacity. See in Index Jeep

"Peeper" frog F-209

Peeping Tom, and Lady Godiva C-386 Peerage, British titled nobility D-32-5 Peerage, Burke's. See Burke's Peerage

(pēr' gint'), Ibsen's Gynt' poetic drama; hero, a character de-rived from Norwegian folklore, is a kind of Norse Faust; Grieg's 'Peer Gynt' suites based on story. Peewit. See in Index Lapwing

Pegasus (pēf/d-sūs), in Greek mythology, winged horse P-100-1
Pegasus, bird-wing butterfly

pupa, picture C-99

Pegasus, a northern constellation, charts S-275e, f, h
Peg'gotty, family in Dickens' 'David Copperfield'; Clara Peggotty, David's loyal nurse, marries Barkis, the start of the control of 'Pervision's the shy carrier ("Barkis is willin").

'Peggy Stewart', burning of M-78, pioture R-86

gler, Westbrook (born 1894). American journalist, born Minne-Pegler. apolis, Minn.; European correspondent in 1st World War, then sports writer; since 1938, syndicated newspaper columnist; noted for his attacks on corruption in politics and in labor unions; awarded Pulitzer prize 1941.

Peg'matite, rock veins rich in feld-spar; a form of pegmatite is "graphic granite" in which the quartz crystals resemble cuneiform

writing; F-22

Pei, W. C. (born 1898), Chinese paleontologist M-45, 46

Pei Ho (pā-hō'), important river of n. China; rises n. of Peking, flows s.e. 350 mi. to Gulf of Pechili at Tientsin T-92

Peiping. See in Index Peking

elpus (pā'ē-pas), also Pelpsijārvi and Chudskoe Ozero, large lake 120 Peipus mi. s.w. of Leningrad on Estho-nian-Russian boundary; drains into Gulf of Finland through Narova River; 1356 sq. mi.; rich fisheries: map E-326e

Peiraievs (pē-rē-ēfs'), Greece. See in Index Piraeus

Pelree (pērs), Benjamin 1880), mathematician and astronomer, born Salem, Mass.; taught at Harvard nearly 50 years.

Peirce, Charles Sanders (1839-1914), American physicist and philoso-pher, born Cambridge, Mass.; son

of Benjamin Peirce; lectured on philosophy at Johns Hopkins, Har-vard, and Lowell Institute; first to formulate doctrine of pragmatism, developed later by Henry James; wrote many treatises on logic, psychology, and scientific subjects.

Peirce, Waldo (born 1884), artist, born Bangor, Me.; best known for paintings of country life as lived by sophisticated city people ('Maine Trotting Race').

Pelsistratos. See in Index Pisistratus Pejer'rey, a fish (Atherinichthys bonariensis) found in lakes and rivers of South America; generally small with dry, delicate flesh; mouth small, feeble teeth; color translucent green with broad lateral band of silver; valued as food.

Pek'an, black marten, or fisher M-72 Pe'kin, Ill., city 10 mi. s. of Peoria. on Illinois River; pop. 19,407; grain and coal trade; corn products, yeast, foundry products, castings, wagons.

Peking (pë/king'), or Peiping (bā'ping'), former capital of China;
pop., with suburbs, about 1,500,000:
P-101-2, maps C-212, A-332a, b
Boxer Rebellion C-2211

Japanese puppet government C-221n Ming tombs P-102 Mongols capture M-223 walls and camels, picture C-38

Pekingese, a lap-dog D-83, picture

Peking man M-45-6 Pekoe tea, picture T-22 Pelag'ic scaling S-70

Pelargo'nium, plant commonly called geranium G-60

Pelecaniformes (pēl-ē-kān-ĭ-fôr'mēz) an order of short-legged water an order of short-legged water birds, comprising pelicans, tropic-birds, boobles, gannets, cormorants, darters, man-o'-war birds.

Pelecypods (pē-lěs'i-pŏdz), or hatchetfooted mollusks M-218

Pelée (pŭ-lā'), Mont, volcano in Martinique M-72, picture W-72a

Peleus (pē'lē-ŭs), in Greek mythology, husband of Thetis and father of Achilles A-8 marriage feast T-142

Pelew (pě-lg') Islands. See in Index Palau Islands

Pelias (pē'li-ds), Greek mythology, son of Poseidon and king of Iolcus; sent Jason in search of Golden Fleece.

Pel'ican, a fish-eating water bird

brown P-103, picture N-33, color plate B-133 foot, picture B-129 white P-103, pictures P-103

Pelican fish, also called swallower,

picture F-69 Pelican Island, Fla. P-103, B-146

Pelican State, popular name for Louisiana L-204

Péligot (pā'lē'gō'), Eugène Melchior (1811-90), French chemist, who isolated uranium.

Pelion (pē'li-ōn), Mount, lofty mountain range in Thessaly, Greece, celhad temple ebrated in mythology; had temple to Zeus and cave of Centaur Chiron; giants are said to have at-tempted to pile Ossa, a peak in Thessaly, upon Pelion to scale summit of Olympus, the abode of the gods; ship Argo built from wood on its slopes.

Pel'la, capital of Macedonia under Philip II and Alexander the Great; birthplace of Alexander the Great:

Pella'gra, a chronic nutritional disease, not contagious or hereditary, causing severe nervous and physical disturbances cause and cure V-311a, 312

Pélleas et Mélisande' (pā'lā-āz ā mā-lē-zānd'), play by Maurice Maeterlinck; forms libretto for opera by Claude Debussy: M-24 opera M-315; story O-232

'Pelle the Conqueror', novel by Andersen Nexö S-36

Pelly, river flowing w. across s. Yu-kon, Canada, about 350 mi.: Y-214 Pelopidas (pē-lŏp'ĭ-dás) (died 364 B.C.), Theban statesman and general, friend and associate of Epaminondas and his aid at Leuctra.

Peloponne'sian Wars G-160-1 causes S-240, A-355 Pericles P-126, G-160

Peloponnesus (pēl-ō-pō-nē'sŭs), ancient name of s. Greece (modern Morea) G-153

flag symbol F-83 Sparta wins control S-240, G-158

Pelops (pē'löps), in Greek mythology, son of Tantalus, king of Phrygia and father of Atreus and Thyestes; Pelops' line was cursed by Myrti-lus, the charioteer to whom he refused to pay a promised bribe; Peloponnesus ("Pelops' island") named for him.

Pelota (pā-lō'tä), See in Index Jaialai

Pelotas (pā-lō'tās), Brazil, seaport on s.e. coast; pop. 155,000; dried meat, flour, soap, leather: map B-226

Peltier, Leslie Copus (born 1900) American astronomer, born Del phos, Ohio; draftsman and farmer; co-discoverer of 5 comets and independent discoverer of 7 others, also variable stars, novae, meteors, aurora borealis.

Pelton wheel, for water power W-52 Pelusium ($p\bar{e}$ - $l\bar{u}'sh\bar{i}$ - $\bar{u}m$), ancient forelusium (pe-ucsni-um), ancient lu-tified city of Egypt at n.e. extrem-ity of Delta of Nile; gave name to e. mouth of Nile; important point in wars between Egypt and Sen-nacherib, Cambyses, Antiochus. and other Eastern monarchs.

Pel'vis, in human skeleton S-156

Pemaquid, Me., old fort M-39-40
Pemaquid Point, Me., rocky point about 40 mi. up coast from Portland

lighthouse, picture M-40

Pem'ba, island of Zanzibar Protectorate, off e. coast of Africa; 380 sq. mi.; pop., with island of Zanzibar, 245,000: Z-216, map E-139

Pem'berton, John Clifford (1814-81) Confederate general; surrendered Vicksburg; V-293
Pem'bina, N. D., town in n.e.; pop. 703: N-165, map N-162

Pembina Mountains, escarpment low wooded hills in n.e. North Dakota.

Pembina River, tributary of Red River, 150 miles long; rises in Pem-bina Lake, Manitoba, and flows through n.e. corner of North Da-kota: map N-162

Rota: map N-162

Pem'broke, Mary Sidney, Countess of (1561?-1621), sister of Sir Philip Sidney, for whom he wrote "The Countess of Pembroke's Arcadia; subject of Ben Jonson's famous epitaph on "Sidney's sister, Pembroke's mother."

Pembroke, Richard de Clare, Earl of. See in Index Strongbow

Pembroke, William Herbert, 3rd Earl of (1580-1630), English nobleman; lord chamberlain at court of James I 1615-25; lord steward 1625-30; chancellor of University of Oxford 1624 when Pembroke college was founded in his honor

Shakespeare's sonnets S-98

Pembroke, Ontario, town on Ottawa River 75 mi. n.w. of Ottawa; pop. 9868; lumber mills, machine shops, foundries, creameries: may C-50c

Pembroke, capital of Pembrokeshire Wales, in s. on estuary, Milford Haven; pop. 16,000; chief industries connected with Pembroke Dock, fortified naval dockyard near by; ruined 11th century castle, reputed birthplace of Henry VII: map E-270a

Pembroke College, Oxford O-260 Pembroke College, women's college in Brown University; founded 1892, present name adopted 1928. See in

Index Brown University Pem'mican, an Indian food B-150 "Pen," a name for cuttlebone C-415

Pen, instrument for writing or draw-

ing P-103-6 fountain P-104, 106: point A-133 quill or reed P-103-4, B-176, picture P-104

ruling pen D-101-2, picture D-102 "siphon" pen used in cabling C-5 steel, m manufacture P-104, pictures

Peña (pā'nya), Saenz (sä'ĕns) (1851-1914), president of Argentina (1910-14) A-281

Pen'ance, sacrament of Catholic church C-232

enurch (-232
Penang (pē-nāng') Island, Straits
Settlemeuts, at n, end of Strait of
Malacca, off w. coast of Malay
Peninsula; 110 sq. mi.; pop. over
200,000; with province Wellesley
(290 sq. mi.; pop. over 140,000) on
mainland forms Settlement of
Penang; cap. George Town: M-43,
map A-332c
Penatas (pē-nāthēs). Poman sods of

Penates (pē-nā'tēz), Roman gods of the storeroom; each family wor-shipped its own Penates, which seem to have varied in different families

worship connected with that of Vesta

V-291

Penatin, antiseptic substance A-223 Penand, rubber-driven plane, picture

Pence, plural of penny. See Penny Penck, Albrecht (born 1858), German geologist and geographer; with Eduard Bruckner produced the standard study of glaciation in the Alps, 'The Alps During the Ice Age' (1901-8).

Pencil P-106-8 stylus E-168, B-175

Pendennis, The History of, novel by Thackeray, said to be largely biographical T-72, 73

Penden'tive, in architecture A-262

Penden'tive, in architecture A-202
Pen'dleton, George Hunt (1825-89),
American political leader, born Cincinnati, Ohlo; Democratic candidate for vice-president 1864; in
U. S. House of Representatives
1857-65, and in Senate 1879-85;
advocate of civil service reform and sponsor of Pendleton Act.

sponsor of Fendicton Act.

Pendicton, Ore., manufacturing city
on Umatilla River 85 ml. s.w. of
Walla Walla, Wash.; pop. 8847; in
wheat-growing and stock-raising
region; has annual cowboy festival,
"The Round-Up": map 0-246

Pendleton Act (1883), civil service A-812, C-248

Pend Oreille (pënd ō-rēl'), lake in n. Idaho, 35 mi. long, map I-8

Pendrag'on, title given to ancient British chiefs in times of danger when they had command over other chiefs or rulers. King Uther, father of Arthur was called Pendragon.

Pen'dulum P-108-9 clocks regulated W-36, 41 compensated F-109 earth's rotation proved by E-133 Foucault E-132-3 Galileo discovers laws G-1 Meinesz, picture P-108 motion, nature of P-192 ore prospecting M-186 torsion P-109: earth weighed with

E-132 Penelope (pē-něl'ō-pi), in the 'Odys sey', wife of Odysseus; proverbial for patient faithfulness: O-206-8

Pene'us River (modern Salamvria, or Salambria), chief river of Thessaly; 100 mi. long; map G-154 in mythology H-282

Penfeld River, short river in extreme w. France; divides Brest: B-234

Pengö (pěn'ga), the monetary unit of Hungary since 1925, coined in varidenominations: nominally worth about 171/2 cents.

en'guin, an Antarctic P-109-10, pictures P-P-284, Z-221 Pen'guin, sea-bird, P-109, 110,

breeding time A-216 feathers F-20

jackass, pioture Z-221 king P-109, 110, pictures P-109, Z-221 Penguin Island', novel by Anatole

France P-109-10

Penicillin, (pěn-i-sil'in), a bacteria-killing substance discovered by Dr. A. Fleming, London, 1929 A-223

Penikose (pēn-i-kēs') Island, at en-trance to Buzzards Bay; 100 acres; Massachusetts state leper hospital Agassiz's school A-46

Penin'sula, in physiography P-198 Europe E-316 largest in world, Arabia A-237

Peninsular Campaign, in American Civil War C-253, M-3

Peninsulares, officials sent from Spain to govern colonies S-2081-209

Peninsular War (1808-14), war in which Great Britain assisted Spain and Portugal to free Iberian Peninsula from domination of Napoleon:

Wellington W-71

Penitentes. See in Index Flagellants Penitentiary. See in Index Prison Penknife, origin of name P-104

Penmanship H-210

Penn, John (1741-88), North Carolina delegate to Continental Congress, signer of Declaration of Independence; born Caroline Co., Va. Penn, Thomas (1702-75), proprietor of Pennsylvania, son of William Penn D-41

Penn, Sir William (1621-70), English admiral, father of William Penn, the founder of Pennsylvania; P-110

Penn, William (1644-1718), founder of Pennsylvania P-110-11 Delaware D-40d, 41, 42 favors universal education E-176

house in Philadelphia, picture P-159 proprietor of Jerseys N-92 statue in Philadelphia P-158

with Indians P-111, picture H-226: celebration in June H-321 Pennacook, an Algonquian con-federacy once living in Merrimac valley and adjacent regions of New Hampshire, n.e. Massachusetts, and s. Maine,

Pen-name. See in Index Pseudonym

Pennant, small flag used chiefly on naval vessels British warship F-85

Pennell (pěn'ēl), Joseph (1860-1926) American artist and writer, born in Philadelphia, of Quaker parents; spent most of time in London after 1884: faultless draftsman; famous etchings and lithographs of architectural, scenic, and industrial subjects; friend of Whistler, whose biography he wrote with his wife, Elizabeth Robins Pennell (1855–1936) ('Etchers and Etching'; 'Pictures of War Work in America'; 'Adventures of an Illustrator').

Penney, J. C., Company, Inc., chain of retail dry goods and clothing stores, started 1902 in Kemmerer, Wyo., by James C. Penney (born 1875 at

Hamilton, Mo.).

Pennine (pēn'm) Chain, England, range of low hills running n. and s. from Tyne River to Derbyshire; rich coal deposits: E-288, map TC-270a

ennsylvania (pěn-sil-vā'ni-a), a middle Atlantic state of U.S.; 45,333 sq. mi.; pop. 9,900,180; cap. Harris-P-111-18, maps U-188c

agriculture P-114, G-136

bird, state B-122 cities P-114-15, list P-111. See also in Index names of cities

commerce and transportation P-114: Philadelphia P-160; Pittsburgh P-224-5

Delaware River and Water Gap T)-42

education P-115-16, pictures P-115, E-183, C-301; early schools E-176 flag F-93, color plate F-87 flower, state S-279 forests, national and state, table

F-250

Gettysburg Park G-82 government P-115: township T-117

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colonial period: founded by Penn
P-110-11, P-116; religious foundations A-151; Delaware included dations A-151; Delaware included D-42; immigration P-116, A-160-1; boundary disputes P-116-17; Fort Duquesne and Braddock's expedition F-194 Franklin's public service F-189, 190 Revolutionary War P-117, R-90; Continental Congress in Philadelphia R-28, 80, 80 actions and P-1916 R-28, 80, 80 actions Related

phia R-85, 86, 89, pictures R-81, U-235; Valley Forge V-269, pic-ture R-89

Constitutional Convention in Philadelphia U-207-8, picture U-206 Whiskey Rebellion W-19

Whiskey Rebellion W-19
Civil War: Gettysburg G-81-2
Hopewell Village N-18
manufactures P-112-14, P-225, P-160,
S-51, W-97: carpets R-174; cement
C-125; iron and steel P-225, P-113
minerals P-113-4: coal P-118;
gas G-23; petroleum P-145, 146
name, origin of, and nickname S-279
natural features P-111-12
neonle P-112, 118

people P-112, 116 products, chart P-112, list P-111

Pennsylvania', United States navy battleship, picture N-50

Pennsylvania, University of, at Philadelphia, Pa.; non-sectarian; established in 1740 as a charitable school; made an academy in 1751 through the efforts of Benjamin Franklin, and became a college 1755; arts and science, biology, chemistry, engineering, architecture, music, education, finance and commerce, law, medicine, veterinary medicine, dentistry: P-159, picture P-115 University Museum, table M-392

Pennsylvania Avenue, Washington, D. C. W-25, pictures W-27, W-173

Pennsylvania College for Women, nonsectarian institution at Pittsburgh, established 1870; liberal arts; speech, social service, music.

Pennsylvania Dutch, descendants of early German settlers in Pennsyl-

vania P-116

tulip ware, pictures P-335, A-173 Pennsylvania Museum of Art, at Philadelphia, Pa., table M-392

Pennsylvanian period, in geologic time G-40

Pennsylvania Railroad station, New York City R-40, picture N-133

Pennsylvania State College, at State College, Pa.; state institution; founded 1855; agriculture, engi-neering, arts and science, mining; home economics.

Penny, an English bronze coin worth enny, an English bronze com worth one-twelfth of a shilling or 4 farthings, 1/240 pound. Silver penny was chief coln of early England; this was deeply indented with a cross to permit breaking into two or four pieces, as half-pence and far-things were not coined until time of Edward I; abbreviation written d. See also in Index Denarius

"Penny." See in Index Cent

"Penny black," stamp, picture S-267 Penny-in-the-slot machine, picture A-384

Pennyroyal, herb of the mint family; its oil used medicinally.

Pennyweight, a unit of measure W-67 Penobscot Indians, division of the Abnaki group, of Algonquian stock; occupied region on both sides of Penobscot Bay and River Maine M-37

Penobacot (pē-nöb'sköt) River, chief river of Maine, rises in w. near Canadian boundary; flows e., then s. to Penobscot Bay, an inlet of the Atlantic: map M-38

Penrod, 12-year-old hero of Booth Tarkington's novel 'Penrod', a real-istic and humorous account of a boy's life.

boy's life.
Pensacola, Fla., port on Pensacola
Bay, six ml. from Gulf of Mexico;
pop. 37,449; fish, naval stores, wall
board, furniture; founded 1696 by
Spanish: figured in War of 1812
and Civil War; U. S. air training
station: F-116, maps F-111, 112

Pensacola Dam, Oklahoma, table D-357 Pensions P-118

definition of Dr. Johnson J-224

definition of Dr. Johnson J-224
literary men granted in England
P-266: Dr. Johnson J-225
mothers' P-118, P-161
old age P-118, S-179; Australia
A-373; England L-173; Germany
G-73; New Zealand N-135
U. S. Veterans P-118; Clvil War
H-230, H-253, P-118; soldiers'
bonus C-353, H-337, R-146j, P-118;
war risk insurance I-95
workmen's compensation E-263,
S-179: insurance I-94-5

S-179: insurance I-94-5 Pensions, Bureau of, U. S. combined with Veterans' Bureau U-231

Penstock, pipe that conveys water for hydraulic power W-52

Pentagon, The, Arlington, Va., head-quarters of U.S. War Department; is a 5-story, 5-sided structure composed of 5 concentric pentagonal "rings" of buildings built around "rings" of buildings built around a 5-acre court; has about 4,000,000 sq. ft.; houses about 30,000 employees; designed by George E. Bergstrom, formerly chief consulting architect of War Department.

Pentam'eter line, in poetry P-269 Pentane, in chemistry. See in Index Paraffin series

Pentateuch (pěn'tà-tūk), first five books of Bible M-265

Pentathlon entathlon (pën-täth'lön), fivefold match in Greek Olympic Games 0-224

Pentatonic scale, in music S-198

Pen'tecost (Greek "fiftieth"), name applied to Jewish Feast of Weeks, also to Whitsunday. See in Index Feast of Weeks; Whitsunday

Pentel'icus, Mount (modern Mendeli), mountain 10 mi. n.e. of Athens (8640 ft.); still supplies white marble of which statues and buildings of ancient Athens were made.

Penthesilea (pěn-thěs-ī-lū'ā), daughter of Ares and queen of the Amazons; aided Trojans against Greeks; slain by Achilles.

Pent'land Firth, channel separating Orkney Islands from mainland of Scotland, map E-270a

Pentlandite, an ore of nickel N-143 Pentode tube, a type of vacuum tube R-23-4, picture R-22

Pentose, a simple sugar S-322

Pentstemon (pent-ste'mon). See in Index Beard tongue

Penum'bra, the outer, partial shadow cast during an eclipse, diagram E-144, picture E-145

Penzance', westernmost port of England, in Cornwall 9 mi. n.e. of Lands End; pop. 11,000: map II-270a

Pe'onage, a system by which laborers are virtually enslaved for payment of debts; developed in Latin of debts; developed in Latin America (mainly Mexico) and also to some extent in southern states of U. S. after Civil War; though system is no longer legal, many of its abuses remain; even when not enslaved, the ignorant native workers of Latin America are still often called peons: S-161-2, L-67g, S-205b, 206d, 2081

Argentina A-280a-b Chile C-207b

Mexico M-140, L-67g Pe'ony, flowering plant P-118-19

"People of the White Rock," Acoma Indians, picture N-95 People's party, or populist party P-293, U-247, H-231

Peoria, tribe of Indians of Algonquian family, one of principal tribes of Illinois confederacy; lived in Illi-nois, Kansas, and Missouri, later removed to Indian Territory.

removed to Indian Territory.

Peoria, Ill., manufacturing and railroad city in n. center on Illinois River; pop. 105,087. Site was visited by Marquette and Joliet in 1673, and by La Salle, Tonti, and Hennepin in 1680. In control of French until 1765, of British until French until 1765, of British until 1778, and of various American ter-ritories until 1818, when Illinois was granted statehood. In 1813 Americans built Fort Clark here to ward off Indian attacks. Real growth of town dates from 1819 when American land-seekers began to arrive; it was incorporated as a village in 1835, and chartered as a city in 1845. Bradley Polytechnic Institute gives training in various technical pursuits including watchmaking. Peoria Public Library was first to be organized under state law of 1872: map I-13 Fort Crevecoeur L-66

manufactures I-16

Pep'in, or Pippin, the Short (died 768), first Carolingian king of the Franks, son of Charles Martel and

father Ωť Charlemagne: Ravenna captured by R-53

Pepin II (sometimes called Pepin of epin II (sometimes called Pepin of Heristal) (died 714), duke of the Franks; as leader of nobles of Austrasia gained great victory over Neustria which made him master of almost entire Gaul; subdued Frisians and Alemanni; father of Charles Martel.

Pepin, Lake, Minn, M-204, vioture M-191

Pep'los, Greek garment D-106, picture D-107

Pepper, William (1843-89), physician, born in Philadelphia; son of William Pepper (1810-64) also physician; for 30 years with Medical School of University of Pennsylvania; in 1874 founded first hospital closely associated with a university medical school; author of 'A System of Practical Medicine'.

Pepper P-119-20, S-249, S-251, P-119

planting, directions G-7, 13

Pepper family, or Piperaceae (pip-ēr-d'sē-ē), a family of plants, native chiefly to the troples, including the peperomia, pepper, cubeb, betel, and macropiper, source of kava.

Pepperidge, See in Index Black gum Pepperrell, Sir William (1686-1759), American soldier, born Kittery, Me.; member of governor's council for Massachusetts 32 years, 18 of which he was president; chief jus-tice of court of common pleas 29 years; made baronet by George II 1746; acting governor of Massachusetts 1756-58; made lieutenantgeneral 1759

King George's war service K-22

Peppermint M-195

Peppermint tree, or stringybark tree, a species of Australian eucalyptus noted for its oil.

Pepper-tree, an evergreen tree (Schinus molte) of the Anacardiaceae; bears yellowish white flowers and clusters of bright red fruit; known also as Peruvian mastic-tree; native to South America and Mexico; grown in America chiefly for ornament.

Pepperwood. See California laurel Pep'sin, protein-digesting ferment in gastric juice P-120, D-68-9, S-292 Peptization, of colloids C-303

Pep'tone, product of pepsin action upon a proteid P-120, D-68, 69

Pepys (pēps, pēps, or pēp'is), Samuel (1633-1703), English diarist, im-portant official in English navy office. His famous diary gives a vivid picture of the life of his time, including the theater and the corrupt court of Charles II; written in his own system of shorthand, it was not published until 1825 home in London L-186

Pequon'nock, early settlement on site of Bridgeport, Conn. B-244

Pequet (pë'kwöt), an Algonquin Indian tribe of Connecticut, originally a part of the Mohegan and the most dreaded of the Indians of s. New England.

Pequot War (1637-38) I-68

monument, picture C-339
Pera (pā'rā), also Beyoglu, suburb
and foreign quarter of Istanbul, n.
of Golden Horn, map I-152

of Golden Horn, map 1-152
Perak (pā-rūk'), one of Federated
Malay States; borders s. Thalland;
7980 sq. ml.; pop. 920,000; M-43
Peralta (pā-rūk'tā), Don Luis Maria
(flourished 1805-20), Spanish pioneer in California; Oakland, Calif.,

once part of his land grants from Spanish crown.

Perbunan, or buna N, rubber R-169a Percale (pēr-kāl), closely woven, dull finished cotton fabric, finer than calico.

Percentage and Interest P-120-2 Perception, in psychology S-76-8, P-860

illusion affects T-19-20

Per'ceval, or Percival, Sir, knight of Round Table G-1, R-160. See also in Index Parsifal

Perch. a fish P-122, F-74 climbing F-73, picture F-69 evolutionary position F-68 skeleton, picture S-155 Tasmanian, picture F-67 Perch, a unit of measure equivalent

to one rod (16½ ft.); in land measure a square rod; in masonry varies from 16½ to 25 cu. ft.

Percheron, a French breed of draft horses H-343, picture A-52

Perch trout, or sand-roller, pale, translucent, spotted fish (Percopsis guttata) reaching a length of six inches; abundant in the Great Lakes and their tributaries.

Percival, James Gates (1795–1856), American poet, philologist, physi-cian, botanist, and geologist, born Berlin, Conn.; state geologist of Connecticut, 1833–42; of Wisconsin, 1854–56; did important work on 'Webster's Dictionary',

Percus'sion cap F-50

Percussion fuses, artillery A-320 Percussion instruments, mt M-321, 323, pictures M-322 in orchestra O-241 musical

Percy, noble English family which came to England with William the Conqueror and held land in north England; family name of earls and dukes of Northumberland.

Percy, George (1580-1632), English colonial governor, son of 8th Earl of Northumberland; joined Virginia expedition 1606; appointed governor 1609; handicapped by ill-ness and mistakes of associates;

ness and mistakes of associates; returned to England 1612. Percy, Sir Henry (1364-1403), "Har-ry Hotspur," English warden of Carlisle and the west marches of Scotland and hero of Chevy Chase

(1388); killed in rebellion against Henry IV: H-276 Percy, Thomas (1729-1811), English bishop, famous for his collection of old ballads ('Reliques of Ancient English Poetry'), which caused re-vival in the study of old ballad

influence on literature E-286

Percy, William Alexander (1885-1942), American lawyer and poet, born Greenville, Miss.; musical lyrics infused with pathos ('In April Once'; 'Sappho in Levkas'; 'Enzio's Kingdom'; 'Lanterns on the Levee'). Perdica'ris, Ion, American held for

ransom in Morocco M-259 Perdicidae $(p\hat{u}r\text{-}d\hat{i}\text{-}s\hat{i}'d\hat{e})$, family birds including partridges a

erdido (për-dë'dō) River, short stream flowing between Alabama and Florida into Gulf of Mexico, may A-98 Perdido

map A-98
Perdita (pēr'dī-tā), in Shakespeare's 'Winter's Tale' W-118
Pereda (pā-rā'dā), José María de (1833-1906), Spanish novelist; describes life in the mountains of n. Spain ('Pedro Sanchey'; 'Sotileza'; 'Peñas Arriba'; 'La Puchera'): S-938

'Père Gorlot' (pêr đô-rē-yō'), novel by Balzac, in which an indulgent father is made victim of his daughter's social ambition and folly.

Peregrine $(p\bar{e}r'\bar{e}$ - $\bar{g}rin)$, a H-246, 247

Peregrine Pickle, hero of Smollett's novel 'The Adventures of Peregrine Pickle'; a wilful young rascal fond of practical jokes.

joins Crimea to mainland C-398 Perekon

Père la Chaise (là shêz), famous cem-etery in n.e. Paris; contains 20,000 monuments and 800,000 graves, including many of the great figures in Erench history.

"Peremptory challenge," in selecting jurors J-230

Peren'nial plants P-244 gardens G-7, 8, 10-11, 12 weeds W-64

Pérez, Antonio (1534 or 1539-1611) Spanish courtier; favorite and adviser of Philip II, who later prosedied in poverty in Paris; wrote 'Relaciones', a vivid account of court life.

Pérez (pā'rāth), Juan (died 1513) Franciscan priest; as adviser of Queen Isabella, influenced her to aid Columbus; accompanied second

voyage.

Pérez de Ayala (pā'rāth dā ä-yä'lä), Ramón (born 1881), Spanish poet, critic, and novelist; called greatest of modern Spanish poets; appointed ambassador to Great Britain 1931; ampassator to Great Britain 1991; traveled widely and gained thor-ough knowledge of foreign litera-tures; married an American ('El Sendero innumerable', poem; La Pata de la raposa', novel).

érez Galdós (pā'rāth gäl-dōs'), Benito (1845-1920), Spanish novelist and playwright; wrote historical novels and stories of contemporary life; vigorous style ('Doña Perfecta'; 'La Corte de Carlos IV'; 'Zarazoga'; 'Electra', a play).

Perfumes P-122-5 ambergris P-124: price of W-80 animal P-124 attar of roses P-124, B-270 crocodile C-399

eau de Cologne C-304 essential oils P-124, F-19 manufacturing processes P-124, 125, pictures P-123

musk deer M-323, P-124, picture D-35

sedge S-73 synthetic P-125 tuberose T-149 vanilla V-273 vegetable P-124-5

Pergamum (pēr'ād-mum), also Pergamus, celebrated ancient city of n.w. Asia Minor, cap. of kingdom of Pergamum and later of Roman prov-ince of Asia; fine sculptures library L-103

parchment named from P-57

Pergolesi (për-gō-ld'zē), Glovanni Battista (1710-36), Italian com-poser; although he lived only 26 years composed number of operas and sacred works ('La Serva Padrona', comic opera; 'Stabat Mater').

Peri (pā'rē). eri (pā'rē), Jacopo (1561-1633), Italian composer, one of the found-

ers of opera O-228

Peri $(p\bar{a}'r\bar{e})$, in Persian folk-lore, a class of beautiful and beneficent fairles; in old Iranian religion the peri were female demons or enchantresses.

Greek sage and tyrant of Corinth: despotic but energetic ruler; patron of literature and music and known as one of the Seven Wise Men of Greece: S-193

Per'lanth, petal and sepal structure of a flower.

Pericar'dium, the serous membrane that surrounds the heart.

Per'icarp, seed-envelope of fruits F-214

Pericles (pěr'i-klēz) (493?-429 B.C.), Athenian statesman P-125-6 beautifies Athens A-11, P-158
Peloponnesian War policy G-160
Pericles, Age of G-158, 160, P-125-6
education E-168-9
pottery P-330

Pericles and Aspasia', book by Walter Savage Landor, comprising imaginary letters, speeches, poems; "a kind of concentrated extract of the Periclean Age."

Pericon (pā-rē-kôn'), a dance L-67k (pěr'i-dot), also chrysolite, ivine, a semiprecious stone Peridot or olivine, G-28, M-184

September birthstone G-25

Périer, J. P. P. Casimir-. See in Index Casimir-Périer, J. P. P.

Perigee (për'i-gë), point of moon's orbit that is nearest the earth.

Per'igon, in geometry G-47

Perihe'lion, point on earth's orbit E-132

Perilla oil, the product of seeds of several related species of Japanese and Chinese plants; U.S. supply chiefly imported drying oil in paints P-32a

Per'ilymph, fluid filling bony cavities of inner ear E-126

Perim (pā-rēm'), island of British colony of Aden at s. end of Red Sea: 5 sq. mi.; pop. 2000; coaling and supply station: A-20, map A-3320

Period, mark of punctuation P-368 Period, of sound S-197

Period, of time, in geology G-40-2 Period furniture I-98-106

Period'icals. See also in Index Newsnaners

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Periodic law of chemical elements C-167b, A-362, table C-168

Periodic motion, in physics, defined P-192

Perioeci (pěr-ī-ē'sī), free laborers of Sparta S-239

vascular Periosteum. membrane which covers bone and supplies it with blood.

Peripatet'ic philosophy, of Aristotle A-284

Perique (pěr-ēk') tobacco L-206. T-103

Per'iscope P-126, S-312. pictures S-313 Perissodac'tyla, an order of odd-toed

hoofed animals, including horses, tapirs, and rhinoceroses: Z-229

Peristal'tic motion D-69

Peristyle, in architecture, a range of columns encircling the outside of a building, an enclosed room, or a court.

Perian'der (died about 585 B.c.), Peritone'um, the serous membrane

that lines the walls of the abdominal cavity and covers the abdominal viscera P-206

Peritoni'tis, an inflammation of the peritoneum P-206

Pertunkle, a gastropod mollusk; edible periwinkle, Littorina litoria, shell rough, dark brown, yellowish or reddish, with dark spiral bands; native to Europe and recently introduced on U.S. Atlantic coast as far s. as Delaware Bay trap door M-219

Per'lwinkle, genus of plants of dog-bane family with opposed ever-green leaves; some plants trailing, others erect: M-326

Perjury, in law, the offense of willfully making false statements, when bound by oath to tell the truth, in the course of judicial proceedings.

Perker, character in Dickens' 'Pickwick Papers', picture D-67

Perkin, Sir William Henry (1838–1907), English chemist

coal-tar dye D-121 fire-proofing process F-59

Perkins, Frances (Mrs. Paul C. Wilson) (born 1882), American sociologist, born Boston, Mass.; appointed sec'y of labor 1983; first woman member, presidential cabinet.

Perkins, Lucy Fitch (1865-1937), artist and author of children's books, born Maples, Ind.; wrote long series of "twin books" on children in other lands ('Dutch Twins', 'Japanese Twins', 'Spanish Twins').

Perkins, Milo R. (born 1900), U. S. government official, born Milwaukee, Wis.; executive director, under Chairman Henry A. Wallace, of Board of Economic Warfare 1941-43; joined U.S. Dept. of Agriculture 1935; important work in farm security, surplus marketing, food stamp plan, etc.

1938), born Lebanon, N.H.; Canadian high commissioner at London 1914-22: minister over 1914-20: Perley, Sir George Halsey 1914-22; minister overscas forces of Canada 1916-17; member of Dominion House of Commons 1904-13, and after 1925; minister without portfolio, Canada 1930-35.

Perlis, an unfederated Malay state;

Perm, an unrederated maray state; 310 sq. ml.; pop. 55,000; M-43

Perm (pērm), U.S.S.R., city on Kama River about 175 ml. n.w. of Sverdlovsk; pop. 255,000; iron, copper smelting, machinery; river trade: map E-326e

Permalloy, an alloy of nickel and iron, having high magnetic perme-

ability: A-131 in cables C-4

Permanent Court of Arbitration H-195, L-77, 78 arbitration made voluntary H-195

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Hughes appointed to H-351
Permanent Court of International Justice (World Court) L-78
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Permanent Joint Defense Board, between Canada and the U.S. C-62

Permanganate (pēr-mān'gā-nāt), any salt of permanganic acid; has one less manganese atom than a manganate: C-175 potassium C-175, M-53 sodium (NaMnO4) M-53

Permeability, magnetic M-34, E-228, A-131

Per'mian period, in geology G-40, picture G-41

Permoser, Balthaser (1651-1732), German sculptor S-59

Pernambuco (pěr-näm-bo'kō), Brazil, state on central seacoast; 38,322 sq. mi.; pop. about 2,900,000; cap. Recife; sugar, cotton, coffee, fruit. Pernambuco, city in Brazil. See in

Index Recife

Pernicious anemia. See Anemia

Peroba (pē-rō'bā), hardwood tree (Aspidosperma polyneuron) of dogbane family, native to S. America. Red peroba belongs to same species Red person belongs to same specimes as white quebracho; wood used for building and furniture. White persona (Tecoma persona) has yellow-brown wood and belongs to another species: picture B-226c

Peronel'la, heroine of a fairy tale; a poor and beautiful little country girl who changes places with a decrepit old queen and enjoys for a time the grandeur of her position, but is soon glad enough to return to her youth, beauty, and rags.

Péronne (pd-rôn'), France, historical town on Somme River, 94 ml. n.e. of Paris; pop. 4000; Charles the Simple and Louis XI imprisoned here; besieged by Charles V in 1536; taken by Germans 1871 and 1914; regained by France 1918; retaken by Germans 1940

in first battle of Somme S-193

Perosi (pā-vō'sē), Lorenzo (born 1872), Italian priest and musician; conductor, St. Mark's, Venice, and of the Papal Choir, Rome; composed trilogy ('La Passione di Cristo'), oratorios, masses, symphonies, and orchestral suites.

Perox'ide of hydrogen, a compound of hydrogen and oxygen (H₂O₂), used as a mild antiseptic and for

bleaching.

Peroxide of sodium, a compound of sodium and oxygen (Na₂O₂), which liberates oxygen when mixed with water; used as bleaching agent. Perpendicular, in geometry G-48

Perpendicular style, in architecture

Canterbury Cathedral, picture C-77 modern buildings A-273

Perpetual calendar, chart C-22

Perpetual League, in Switzerland S-351, T-43

"Perpetual motion" machines E-266 erpignan (pêr-pēn-yān'), France, fortified city in s. on Têt River, 7 Perpignan mi. from Mediterranean; pop. 72,-000; 14th century cathedral; com-mands passage by e. Pyrenees from Spain into France.

errault $(p\hat{e}-r\hat{o}')$, Charles (1628–1703), French author who gave literary form to many old fairy tales L-158, S-3034-j Perrault

Perrot, François-Marie (flourished 1669-91), French soldier and governor of Montreal 1670-84; maintained trading post on Isle Perrot near Montreal, engaged in illegal trade with Indians, exchanging brandy for furs; protected lawless coureurs de bois; arrested by Frontenac and sent to France but later regained governorship.

Perrot, Nicolas (1644?-1717), Canadian voyageur and fur trader, born France; emigrated to Canada when a child; employed by Jesuits and Sulpicians; interpreter for Algonquins; 1684 persuaded western tribes to join La Barre in campaign against Iroquois; 1693 discovered lead mines in Mississippi valley.

Perry, Bliss (born 1860), American François-Marie (flourished Perrot,

Perry, Bliss (born 1860), American writer, editor, and educator, born Williamstown, Mass.; professor of

English at Williams College, Princeton, and Harvard; editor of Atlantic Monthly, 1899–1909 ('The Broughton House', fiction; 'The American Mind', essays; 'A Study of Prose Fiction', criticism; 'Walt Whitman', 'Whittier', biography).

Matthew Calbraith (1794 -1858), American commodore, brother of O. H. Perry; served in War of 1812; in charge of construction and later in command of first steam vessel of U.S. navy; in command of fleet in Gulf of Mexico during part of Mexican War expedition to Japan F-34, J-184, J-191a, picture J-185

Perry, Oliver Hazard (1785-1819), American naval officer, hero of bat tle of Lake Erie P-126, picture W-9 flag F-99, color plate F-90

Perry's Victory and International Peace Memorial, national monument in Ohio N-22c

Perryville, Ky., town 40 mi. s. of Frankfort; pop. 462 Civil War battle C-255, map C-253 Perseids (pēr'sē-idz), meteor group M-128

Persephone (pēr-sēf'ō-nē), or Proser-pina, in Greek and Roman mythol-ogy, daughter of Demeter (Ceres) D-44-5

changes rival to mint plant M-195 ersepolis (pēr-sēp'ō-lis), ancient capital of Persian Empire, 30 mi. n.e. of modern Shiraz; probably became capital under Darius I; gradually declined after being sacked by Alexander 330 B.c.; another city, Istakhr, rose there about Persepolis 200 A.D. and had several centuries of prosperity; ruins of colossal buildings and sculptured tombs.

Perseus (pûr'sūs or pēr'sē-ŭs), in Greek mythology, hero who slew Medusa P-127-8 statue by Cellini, picture S-58

Perseus, a northern cocharts S-275, 275e, f, g a northern constellation,

Perseus of Macedonia (212-161 B.C.). last king of Macedonia; defeated and captured by Romans under Aemilius Paulus (168 B.C.): L-103

Pershing, John Joseph (born 1860), American general P-128-9 Mexican expedition M-142e

Philippines P-129
1st World War W-171-3, U-249: Argonne A-282; Saint-Mihiel S-10

Persia (pēr'shā or pēr'zhā) (official name Iran), a mountainous country of s.w. Asia; 628,000 sq. mi.; pop. 15,000,000; cap. Teheran: P-129-34, maps A-332a, b-o agriculture P-131, 132

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Persian cat C-96, pictures C-96, 97 Persian guzelle hound, or Saluki D-83
Persian Gulf, arm of Indian Ocean
separating Persia from Arabia
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Persian lamb, trade name for tightly curled fur obtained from very young Asiatic lambs.

Persian language P-171 Persian Ilterature P-134 folk-tales S-303b: list S-3031-m

Persian rugs R-171, 172, color plate R-170a-b

Persian smoke, cat, picture C-96 Persian walnut, or English walnut W-5-6

Persian Wars (493-479 B.C.) P-134-6 effect on Greek art G-165 effect on Greek culture E-168 Marathon P-135, M-60 method of warfare A-307f Phoenician navy P-174 Salamis S-13, P-136: Aristides A-283 Thermopylae P-136, T-79

Persian wheel, a primitive type of pump P-366, picture W-43

Persia pitch T-12 Persim'mon, a fruit tree P-136 Persistence of vision E-352, M-280

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development in painting P-15, 16 gained by foreshortening D-100 how brain perceives E-353 optical illusion in I-19

Perspira'tion S-157 Porth (porth), capital of Western Australia in s.w. on Swan River 12 mi. above port of Fremantle; pop. with Fremantle 210,000; university; A-374, maps A-372a, b

Perth, Scotland, capital of Perthshire on Tay River 32 ml. n.w. of Edin-burgh; pop. 35,000; rope and twine, textiles, dyes; stock market; scene of murder of James I of Scotland (1437): map E-270a

Perth Amboy, N.J., industrial city and port 20 mi. s. of New York, with large shipping interests, especially of coal; pop. 41, 242; ceramic wares, cigars, metal products, automobile parts; boat-building: map N-90 Perthes, Boucher de. See in Index

Boucher de Crèvecoeur de Perthes Perturbation, in astronomy, the deviation of a planet from its exact ellip- | Pescadores

tical orbit, caused by changing attraction of other planets.

Peru (pē-ra', Spanish pā-ra'), republic on Pacific coast of South America; 485,000 sq. mi.; pop. 7,000,000; cap. Lima: P-137-41, maps P-140, S-208b, d, Outline S-211
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Andes Montains A-194, 195
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use by natives R-163 shelter: houses of Lima L-137; ruined palace of Yuncas, picture A-253

textiles T-62-3, picture T-63 transportation P-138, 140, picture

Peru, Ind., commercial center for agricultural region, about 70 ml. n. of Indianapolis on Wabash River; pop. 12,432; steam bollers, woodwork, heating specialties; railroad shops: man 1-48

Perugia (pā-ro'ġā), Italy, historic city on Tiber River 84 ml. n. of Rome; pop. 83,000; cathedral and other interesting buildings; Etruscan gateways, frescoes by Perugino; old university (13th century); ancient Perugia was one of the price 12 principal cities of Etruria; taken by Romans 810 B.C.: maps I-156, E-326d

Umbrian School of painting P-16 Perugino (pā-ro-jē'nō), "easel name" of Petro Vannucci (vān-not'ohē) (1446-1524), of Perugia; created classic type of Madonna and molded early style of Raphael chief of Umbrian School P-16

Raphael and R-50 Peru'vian balsam. See in Index Bal-

Peruvian bark, bark of the cinchona tree, from which quinine is ob-tained Q-8

Peruvian cotton C-382

sam of Paru

Peruvian daffodil, a perennial plant of the amaryllis family, native to w. S. America. Sometimes classed as Ismene calathina but placed botanically as Hymenocallis calathina in the spider-lily genus; leaves long, succulent; flowers fragrant white fuller with leaves long, succulent; flowers, fragrant, white, tubular, with fringed edges produced by the partially attached stamens; also called basket-flower.

Pesaro (pā'zā-rō), Italy, seaport on Adriatic at mouth of Foglia River; pop. 85,000; several palaces; silk, ships, ironware, earthenware; founded by Romans as Pisaurum 184 B.C.

(pes-ka-do'res) ("fish-

ers' islands"), an island group (50 sq. mi.) between China and Formosa; belongs to Japan. Name also given to small group off Peru. Name

Peseta (nā-sā'tā), silver coin, unit of Spanish monetary system; in practise gold pesetas have been standard since 1901; worth about 20 cents U.S. money but not in circulation; also used in Colombia.

Peshawar (pē-shā'war), capital Northwest Frontier Province, British India, on Bara River 19 mi. e. of Khyber Pass; pop. 120,000; center of trade with Afghanistan: I-30, maps I-30, A-332b

Peshkof, Alexis. See Gorky, Maxim Peso $(p\bar{a}'s\bar{o})$, the monetary unit of Uruguay, Cuba, Argentina, Colomthe Philippines, le. For value in bia, Paraguay, the Philip Mexico, and Chile. For val each country see table M-378

Pes'simism F-6, O-236

Pest, Hungary, old town, now part of Budapest B-258

estalozzi (pős-tű-lőt'ső), Johann Heinrich (1746-1827), Swiss edu-cational reformer, chief founder of modern teaching methods E-180-1 Pestalozzi Pests, insect I-89-90, 88. See also in

Index Insect pests

stain (pā-tān'), Henri Philippe (born 1856), marshal of France; commander of French army at Ver-Pétain. dun 1916; general-in-chief of French armies on w. front after May 1917; inspector-general of French army 1922-81, sec'y of war 1934; called from retirement 1939 to act as ambassador to Spain

military operations (19 W-159, 161; Verdun V-283 W-178i, j president, France F-184,

Petals, of flowers F-120-1 classification by B-205 structure, pictures F-122-3

Peten (pā-tēn'), Guatemala, plain at base of Yucatan peninsula G-181c Mayan ruins G-181d

Peter. See also in Index Pedro

eter, Saint, one of the twelve Apostles, called Simon Peter; fes-tival with that of St. Paul, June 29: P-141

relation to papacy P-55 Peter I, the Great (1672-1725), czar of Russia P-141-3, R-184 Bering's explorations B-97

Charles XII (Sweden), wars with C-154, P-143 flag of Russia, origin F-96

palace at Peterhof, picture L-95 St. Petersburg (Leningrad) founded

Peter III (1728-62).emperor Russia, imbedile grandson of Peter the Great; after 6 months' rule de-posed, July 1762, by wife, Catherine II; probably murdered in prison makes peace with Prussia S-84

Peter I, Kara-Georgevitch (1846-1921), king of Serbia S-81

Peter II (born 1923), king of Yugo-slavia, son of Alexander I Y-212, picture W-178t

Poter, the Hermit (died 1115), French monk, "revivalist" preacher of First Crusade C-403

Peter, Epistles of, two books of New Testament ascribed to Apostle Peter; urged Christians to conduct themselves in exemplary man-ner, avoid false teachings: P-141 Peter and Wendy', fairy tale by Barrie B-51

Peterborough (pë'tër-bor-5), England, city on Nene River about 70 mi. n. of London; pop. 44,000; famous old cathedral (begun 12th century); agricultural implements, locomotives.

Peterborough, N. H., town 27 ml. s.w. of Manchester; pop. 2470; home and burial place of Edward A. Mac-Dowell in whose honor an annual music festival, inaugurated in 1910 by Mrs. MacDowell, is held: M-5 library L-106a

Peterborough, Ontario, Canada, man-ufacturing city and farming and dairying center 70 mi. n.e. of Tor-onto; pop. 22,327; immense elec-trical power; machinery, dairy supplies, farm implements, cereals, shoes, clocks, lumber products, tex-

shoes, clocks, lumber products, tex-tiles, canoes: map C-50c Trent Canal lock, picture O-227 Peterhof (pā'tēr-hôf), Russia, town on Gulf of Finland, near Leningrad; formerly summer residence of royalty

palace, picture L-95

'Peter Ibbetson', a romance by Du Maurier in which the hero, Peter, Maurier in which the hero, Peter, and heroine, Mimsey, separated in actuality, join each other in their dreams; story used in opera by Deems Taylor, produced at Metropolitan Opera, New York City, 1920.

Peterkin, Julia (born 1880), American novellst, born South Carolina;

writes distinctive, earthy tales the Gullah Negroes in s. U.S.; awarded Pulitzer prize, 1929, for her 'Scarlet Sister Mary' ('Green Thursday', short stories; 'Black April').

Peter Lombard (1100?-60), Italian theologian and teacher; made bishop of Paris 1159 ('Four Books of Sentences', famous theological texthook)

Scholasticism P-173

'Peter Pan', fairy play by Sir James M. Barrie, first presented in 1904 B-51

Maude Adams in, picture D-96 statue, picture B-51

Statue, protected of Mitkoff Island, s.e. Alaska, 111 mi. n.w. of Ketchikan; pop. 1323; halibut, salmon, shrimp fisheries; fox and mink farms: map A-105

Petersburg, Va., industrial city on Appomattox River 22 mi. s. of Rich-mond; pop. 30,631; trade in to-bacco, lumber, and peanuts; trunks and bags, pens and pencils, optical goods; famous for 290 days siege in Grant's campaign against Rich-mond: maps V-306, C-253

Petersburg National Military Park, in Virginia, near Petersburg; established 1926 to commemorate Civil

Hungarian-American artist and author, born near Budapest, Hungary; collaborated with his wife, Maude Petersham, in writing and illustrating children's books ('The Christ Child'; 'Miki'; 'Story Books of Information'). War battles. Petersham,

Peterson, Roger T. (born 1908), or-nithologist, born Jamestown, N. Y.; illustrator and author of popular books on birds ('Field Guide to the Birds'; 'Junior Book of Birds').

Peter's pence, formerly an annual tax of a penny to be paid to the pope; now a voluntary offering by de-yout Roman Catholics for the use of the pope.

Petiole (pěťi-ōl), of leaves L-90 Petitgrain oll, an oil distilled from leaves and twigs of bitter orange tree, sometimes of sweet orange tree; used in perfumes.

Petition, formal written supplication or request to a governing power for some favor, redress of grievance, or the like.

Petition of Right, declaration of cer-tain rights and privileges of sub-lects granted by Charles I 1628. Petit (pēt'i) jury, or petty jury J-229-80

developed by Henry II H-275-6
Petit point (pēt'i point), a type of needlework T-66, picture T-68
Petit Rhone (rōn), branch of Rhone R-100

Petit Trianon (trē-à-nôn') Palace, or Little Trianon, at Versailles V-289 Petjenga. See in Index Petsamo

Petos'key, Mich., resort on Little Traverse Bay, 60 mi. n.e. of Tra-verse City; pop. 6019: map M-153 passenger pigeons P-215

Petra (pë'trå), ancient city in mountains of s.w. Trans-Jordan; once important caravan center; cap. of tanis of s.w. Trans-Jordan; once important caravan center; cap. of Nabataeans; absorbed into Roman Empire 106 A.D.; many remains, especially temples and dwellings hewn out of cliffs: map A-242 Treasury of Pharaoh, picture A-325 Petrarch (pëtrirk) (Francesco Petrarca, pā-triir'ki) (1804-74), Italian lyris not scaledor and not scaledor.

Italian lyric poet, scholar, and patriot, second to Dante alone in Italian poetry: R-73-4, picture T-153

sonnet form P-270 Pet'rel, a sea bird P-143 Antarctic species A-216 care of young B-128

Petrie (pē'trī), Sir (William Matthew)
Flinders (1852-1942), English archeologist; directed many excavations in Egypt and Palestine; professor of Egyptology, University College, London, 1892-1983; author of books on Egyptian history and antiquities; knighted in 1923 alphabetic writing in Sinai A-135

Petrified forests P-143
Arizona A-288, map A-289
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Wyoming W-192

Pētrin (pā-trăn'), b trough, picture I-101 bread-kneading

Petroglyph (pěťro-glif), a carving on rock American Indian, picture I-63 Behistun rock, Persia, picture P-135

Pet'rograd, former name of Leningrad, Russia L-94. See also Leningrad Petrol, another name for gasoline. See in Index Gasoline

Petrola'tum, a greasy substance distilled from petroleum P-149 Petro'leum P-144-53

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pictograph M-188a cracking process P-149 crude oil, types P-148-9 distillation, fractional P-149 fuel value P-160-1, F-215-16 gasoline P-149-50 geologic age G-40, P-145-6, picture P-147

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British interests M-141-2

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Petroleum Conservation Division, in

Petroleum Conservation Division, in U. S. government U.230
Petroleum V. Nasby. See Nasby
Petrol'ogy, study of rocks R-121
Petronius, Gaius, or Titus, Roman
novelist; companion to Nero and
director of his courtly pleasures;
known as Petronius Arbiter; wrote
'Satyricon', a comic romance depicting the voluptuous pleasures
and vices of the age.
Petropavlovsk, U.S.S.R., industrial city
on Ishim River in w. cent. Siberia:

on Ishim River in w. cent. Siberia; pop. 90,000. Petropavlovsk-Kamchatski, chief town

Petropaviovsk-Kamehatski, chief town and naval base on s.e. coast of Kamehatka peninsula.
Petrovitch, George. See Kara-George Petruchio (pē-tru'ohi-ō), hero of Shakespeare's 'Taming of the Shrew', who tames Katherine, "the shrew," into a model wife.
Petsamo (pēt'sā-mō), Swedish Petjenga, Russian Pechenga, territory and port, n. Finland, on Arctic Ocean; ceded by Russia to Finland 1920; taken by Russia in Russo-

Finnish War of 1939-40, but returned to Finland in exchange for right of free transit; map E-326e

Pets and their care P-153-6. See also in Index Canary; Cat; Dog; etc. beetles B-82: water-scavenger B-85 bibliography H-313f

crows C-403 fleas, how to get rid of F-106 horned toad L-172

pigeons P-156, P-216

raccoon R-9

raccoon H-9
Pettie (pět'ti), John (1839-93), Scottish portrait, historical, and genre painter, born Edinburgh; specially noted for paintings of 17th-century life in Scotland ('The Vigil'; 'Jacobites, 1745'; 'Distressed Cavaliers'; 'Flag of Truce'; 'Bonnie Prince Charlie').

Pettigrew, James J. (1828-63), Confederate general N-160

Petty-Fitzmaurice. See in Lansdowne

Petty Jury. See in Index Petit jury Petty officer, in U. S. Navy N-56d uniform and insignia U-180-1, picture U-179

Petunia (pē-tu'nī-à), an annual gar-den flower P-156-7

planting, when and how G-7-8, 11 Petun'tse, Chinese name for variety of feldspar P-330

Pe'wee, name of various flycatcher birds F-129, 130

camouflaged nest B-126 Pew'ter A-132

colonial A-174, pictures A-173 metal working M-124

Peyote $(p\bar{d}-y\bar{o}'t\bar{a})$, a small cactus grown in southwestern United States and Mexico; used by Indians, who consider it of divine origin, to produce languor and to stimulate the imagination in religious rites; scientific name Lophophora williamsii.

Pfalz (pfälts), German name for Palatinate

Pfennig (pfěn'if), a bronze coin, formerly a monetary unit of the Free City of Danzig worth about 1/5 cent in U. S. money; German pfennig called reichspfennig since 1924, worth about 2/5 cent.

Pfister, Lester (born 1897), American farmer, born McLean County, Ill.; developed hybrid seed corn: C-367

Pforzheim forzheim (*pfôrts'hīm*), Germa manufacturing town in Baden, Germany mi. s.e. of Karlsruhe; pop. 79,000; famous for jewelry.

famous for jewenty.

Phacelia (fd-s8'll-a), a genus of plants, usually annuals, of the water-leaf family; tubular flowers, blue, purple, or white, in clusters.

Some have hairy, ill-smelling foliage; sometimes called bee's friend.

Phaeacians (fē-ā'shānz), in Greek mythology, people who inhabited mythology, people who inhabited island of Scheria (probably Corfu) entertain Odysseus O-205-6

Phaedo (fê'dō), Greek philosopher, pupil of Socrates and said to have been present at his death. Title of a dialogue by Plato which treats of immortality of the soul and the last hours and death of Socrates.

Phaedra (fêd'ra), in Greek mythology the sister of Ariadne and wife of Theseus; fell in love with her stepson Hippolytus who spurned her; infuriated, she caused his death and in remorse committed suicide; story used by Seneca, Euripides. and Racine.

Phaedrus (fē'drus), Roman writer of fables copied after Aesop; lived

in early days of Roman Empire; a

Phaeophycene (fe-ō-fi'sē-ē), the class of brown algae B-205

Phaethon (fa'e-thon), in Greek mythology P-157

Phagocytes (fäg'ō-sīts), body cells that destroy bacteria and other harmful cells (from Greek words meaning "eat" and "cell"); term applied especially to white blood cells (leucocytes): B-157a, picture

Phalanger (få-län'ger), a marsupial

gray opossum, picture A-372

Phalanges (fü-län'göz), (plural of phalanx), scientific name for bones of toes or fingers H-207, F-146, of toes or fingers H pictures H-208, S-156

Phalanx (fā'lānks), ancient battle array A-307f of heavily-armed infantry

Macedonian A-114 Sparta and Thebes T-78, picture

Sumerians first to use, picture B-7 Phalarope (făl'a-rop), a bird B-131

Phalerum (fă-lē'rum), one of ancient harbors of Athens, chiefly used before Persian Wars; superseded by port of Piraeus.

Phanerogams, spermatophytes, flower-ing plants, or seed plants, the high-est group of plant life P-236, 244, Outline B-205

Pharaoh, Treasury of, ruin in Petra. Arabia, picture A-325

Pharaohs $(f\bar{a}'r\bar{o}z)$, kings of ancient Egypt E-203-10 on way to temple, picture E-205

Rameses II, picture E-207 Pharach's rat, an ichneumon I-6

Phar'isees, most powerful and exclusive Jewish sect at time of Christ; especially exact in observance of traditions and ceremonies

Jesus denounces J-214

Pharmaconcia (fär-må-kō-pē'yā), U. S. D-114

Pharmacy (fär'mā-si), science of compounding, preserving, and dispensing medicines

Arabs lay foundations M-216 drugs D-114 vocation V-323

Phares (fa'ros), famous lighthouse of Alexandria, one of Seven Wonders of World S-82, L-132, picture S-83

Pharos, island at mouth of Nile A-116 Pharphar (fär'pär) (now Awaj), and Abana, or Amanah (now Barada), two famous "rivers of Damascus" mentioned in Bible (II Kings v, 12).

Pharsalus (fär-sā'lūs), now Pharsala, Greek city of s. Thessaly; battle between Caesar and Pompey (48 B.C.): P-302

Pharynx, a part of the alimentary canal between the mouth and the esophagus P-206

Phase rule, in chemistry C-179

Phases of moon M-250 Phases of planet Venus P-230-31 Pheasant (fez'ant), a long-tailed fowl-

like bird P-157 eared, color plate B-130 ruffed grouse miscalled G-180

Pheasant family, the Phasianidae, bird family of the poultry order; includes chickens, peacocks, pheasants, turkeys.

Pheasant's eye, a flowering annual. See in Index Adonis

Pheidippides (fi-dip'i-dez), Athenian runner M-60

Phelps (fělps), Elizabeth (Mrs. Herbert (1844-1911) Ward), American author, born Andover, Mass. ('Gates Ajar', deals with problem of life after death),

with problem of life after death),
Phelps, William Lyon (1865–1948),
American literary critic, born New
Haven, Conn.; professor of English
at Yale University 1901–33 ('Essays on Russian Novelists'; 'The
Advance of the English Novel';
'Essays on Modern Dramatists').

Phe'nix City, Ala., city on Chatta-hoochee River, suburb of Colum-bus, Ga.; pop. 15,351; textile mills: map A-98

Phe'nol, or carbolic acid C-81-2. See also in Index Carbolic acid

Phenolic resins P-245k, 1, 246 Phi Beta Kappa (fi bē'tā kāp'a), honorary society, founded at College of William and Mary U-258

Phidias (fid'i-de) (500?-430? B.C.), greatest Greek sculptor P-157-8, G-166

Acropolis beautified by A-11-12 Parthenon sculptures G-166, S-53-4 statue of Zeus S-82, picture S-83

Phigalia (fi-fa'li-a), an ancient Greek city in Arcadia among high mountains of the Peloponnesus; at Bassae, about 6 mi. away, are the ruins of a beautiful Doric temple of Apollo, designed by Ictinus, from which an almost perfect frieze (the Phigalian Marbles) has been removed to the British Museum.

Philadelphia (fil-à-dēl'fi-à), Pa., chier city of state and 3d city of U. S.; pop. 1,931,334: P-158-60, map P-112 capital of state, also of Federal gov-

ernment at one time P-160 captured by British (1777) R-90 colonial trading center A-165 Constitutional Convention U-207-9 Continental Congress R-85 customhouse, historic site N-18

Federal Reserve Bank (3rd) and district, map F-22

first medical school in U.S. E-182 founded by Penn P-111 harbor P-160

Hog Island S-126, picture W-168 industries P-160: carpets R-174 Liberty Bell D-29, picture D-28 museums P-160, picture P-115. also in Index Museums, table U. S. Mint M-196-7

University of Pennsylvania, College Hall, picture P-115 zoölogical garden Z-224

Philadelphia, ancient city; modern Amman, cap. of Trans-Jordan. See in Index Amman

Philadelphia', U. S. frigate Decatur's exploit D-23

Philadelphia cream cheese C-165 Philadelphia Industrial Museum. See in Index Museums, table

Philadelphia Light Horse Troop flag F-98-9, color plate F-90

Philadelphia Museum of Art P-160.

See also in Index Museums, table
Philadelphia Navy Yard (League Island), on Delaware River, established 1876; builds and repairs all types of naval vessels P-160

Philae (fi'le), Temple of, on island of Philae in Nile River; erected by Egyptians to goddess Isis, 4th century B.C.: E-211, picture E-210

Philan'thropy and charities P-160-2. See also in Index Foundations; Social service

Philately (fi- $lat'\hat{e}$ -li), stamp collecting S-269

Philby, Harry St. John Bridger (born 1885), British explorer, born Cey-lon; held various political offices in

Mesopotamia, Arabia, and Trans-

Arabian Desert crossed E-346

Philemon, Epistle to, book of New Testament; written by Paul during first captivity at Rome entreating the compassion of Philemon for his runaway slave whom Paul has converted to Christianity and is sending back to his master.

sending back to his master.

Philemon and Baucis (fil-ē'mon and ba'sis), a mythical Phrygian man and wife described by Ovid in his 'Metamorphoses', who befriended Jupiter and Mercury, in disguise, after all others had refused; in return they were saved from a flood which destroyed their village; their cottage was changed into a temple, and Jupiter granted their wish that they might both die at the same time by turning them into trees— Baucis into a linden, Philemon into

Philharmon'ie Society M-316

Philhellen'ie movement, in art S-60 Philip, one of the Twelve Apostles; commemorated as saint May 1: A-229

Philip, "the evangelist," one of the salem church (Acts vi, 5); preached in Samaria; sometimes confused with Philip the Apostle.

Philip I (1052-1108), king of France; took advantage of quarrels among his powerful vassals to enlarge crown holdings

ancestry P-162

Philip II, Augustus (1165-1223), king of France P-162

aids rising against Henry II H-276 Third Crusade C-404: quarrels with Richard I R-103-4

wins Normandy from England N-149 Philip IV, the Fair (1268-1314), king

of France P-162-3 Boniface VIII seized B-174 calls first Estates-General E-304 Knights C-406-7 Templars suppressed

Philip VI (1293-1350), king of France D_189

at battle of Crecy H-357

Philip II (382-336 B.C.), king of Macedon, father of Alexander the Great, and conqueror of Greece A-113, 114, G-161 Demosthenes denounces D-49

phalanx, use of A-307f

Philip I (1478-1506), king of Spain; son of Maximilian I and Mary of Burgundy; right to Castile and Aragon through wife Joanna dis-puted by his father-in-law Ferdi-nand; father of Charles V.

Philip II (1527-98), king of Spain

Armada defeated A-300-1 Inquisition S-230 intrigues in France P-163, H-279 Madrid royal capital M-22 marries Mary of Englaud M-73 Netherlands revolt W-103, N-7 Portuguese crown seized P-314

Philip III (1578-1621), king of Spain, a pious but feeble ruler; final ex-pulsion of Moors from Spain (1608-9) weakened the nation and

started its decline.

Philip IV (1605-65), king of Spain, incapable administrator; reign marked by rapid decline of Spanish power

velasquez and V-273
Philip V (1638-1746), king of Spain, grandson of Louis XIV, first of Bourbon dynasty P-163, B-207, T -- 202

Philip, King, the Indian chief Meta-comet (1639?-76), sachem of Wampanoag in Massachusetts; son of Massasoit; leader of King Philip's War (1676) against New England colonists: K-22-3

Philip, "the Good" (1396-1467), duke of Burgundy; signed treaty of Troyes for France; later aided English against France, gaining considerable territory; patron of commerce and industry

founds order at Bruges B-252

Philip of Swabia (1177?-1208), German king and duke of Swabia; youngest son of Frederick Barbarossa and member of house of Hohenstaufen; murdered while disputing, with Otto IV, his claims to Holy Roman Empire: O-256

Philippe Egalité. See in Index Or-léans, Louis Philippe, Duke of

Philippeville, Algeria, seaport in n.e.,

port for Constantine; pop. 66,000: maps A-127, A-42a Philippi (ff-llp'i), ancient city of n.e. Macedonia; named from Philip II of Macedon; Paul's Epistle to the Philippians

battle of (42 B.C.) A-364

Philip'plans, Epistle to, book of the New Testament; letter from Paul to Christians at Philippi reassuring them of his prospects of release and appealing for unity in their church; probably written at Rome shortly before his release 63 A.D.

'Philip'pics' Cicero C-236 Demosthenes D-49

Philippine (fil'i-pen) Islands, archipelago between China Sea and Paperago between China Sea and Fa-cific Ocean; 114,400 sq. mi.; pop. 16,000,000; cap. Manila: P-164-70, maps A-332a, c, P-10b, P-168 agriculture P-168-9

cable connections C-9

citizenship of natives, in the United States C-239 climate P-165

coat-of-arms F-93, color plate F-87 education P-167-8 forests P-169

government P-170 history P-169-70 Magellan M-28

Dewey and Spanish-American War S-235, D-58-9

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Pershing P-129 independence P-170

war with Japan P-170, W-178w, x: General MacArthurat Bataan M-1 Manila M-53, pictures P-165, 168, 169

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undeveloped natural resources. P-169

piña cloth P-221 public health and sanitation im-proved P-167

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transportation P-169, picture P-165 woman suffrage W-133

Philippine mahogany M-37. See also in Index Lauan

Philippines. University of the P-168

Philippopolis (fil-i-pop'o-lis), garia. See in Index Ploydiv

garia. See in index Flouriv Philipsburg, N.J., city on Delaware River 50 mi. n. of Trenton; pop. 18,314; railroad shops, iron and steel manufactures; silk mills: map

hilis'tia, ancient country of Philistines in s.w. Palestine. Philis'tia. of the

Philis'tines, tribe of ancient Canaan P-170

David defeats D-19

Phillips. (Clarence) hillips, Coles (Clarence) (1880– 1927), American artist, born Springfield, Ohio; prominent for magazine covers and illustrations depicting beautiful young women; pioneer advertising illustrator.

Phillips, Stephen (1868-1915), English poet and dramatist; dramas in blank verse include 'Paolo and Francesca', 'Herod: a Tragedy', and 'Ulysses'; 'Marpessa' is one of

best known poems.

Phillips, Wendell (1811-84), American Abolitionist orator, born Boston; educated as lawyer; eloquent and radical in support of antislavery cause; supported women's rights and many other reforms; introduced direct colloquial style of American oratory

Abolitionist movement C-249, G-17: meeting on Boston Common, pic-

ture II-245 Women's rights W-139

Phillips Exeter Academy, boys' school at Exeter, N. H.; founded 1782. Phillips University, at Enid, Okla.; founded 1907 by Disciples church; arts and sciences, fine arts, Bible

college.

Phillpotts (fil'pots), Eden (born 1862), English novelist, born in India, the son of an army officer; educated in England; tried acting, and was in business for 10 years; wrote poems, plays, and mystery and historical novels but is best known for stories of Devonshire country and people ('Children of the Mist'; 'Sons of the Morning'; 'The Jury'; 'Widecombe Fair'; 'One Hundred Sonnets').

Philo, or Philo Judaeus (fi'lo ju-de'as) (20 B.C.-40? A.D.), Hellents-tic-Jewish philosopher; lived in Alexandria; sought to harmonize Greek philosophy and teachings of Moses.

Philology (fi-löl'ö-gi) P-170-2. See also in Index separate languages, as English language. French language, etc.

helps in study of early man P-171:
"wagon," an example T-121
personal names N-2-3

slang S-158

Philomel (fil'ō-mēl), or Philome'la, poetic name for nightingale. Philopoeuc name for nightingale. Philo-mela, in Greek mythology, was sis-ter of Procne, wife of Tereus, king of Thrace; in revenge for their wrongs the sisters killed Itys, Tereus' son, and served him as food to his father; the gods punished them by turning Procee into a swallow and Philomela into a nightingale.

hilosopher's stone, mythical sub-stance with miraculous powers sought by alchemists C-178 Philosopher's

Philosophical Society. American Philosophical Society

Philosophy (fi-los'ō-fi) P-172-3 English philosophers P-173 ethics E-306

French philosophers P-173 German philosophers G-62-3, P-173 reek philosophers E-169-70, P-173 G-173-4,

Roman philosophers P-173

Phineus (fin-yūs' or fin'ē-ŭs), in Greek mythology, Thracian king; tormented by Harpies H-227

Phips, Sir William (1651-95), American sea captain, royal governor of Massachusetts (1692-95); an illiterate shepherd and ship carpenter in his youth, he rose to baron-etcy by raising a Spanish treasure ship sunk off Bahama Islands (1687); led successful surprise attack on Acadia, but was defeated by Frontenac at Quebec (1690). Appointed governor of Massachustis through influence of Catton setts through influence of Cotton Mather, he suppressed witchcraft trials and built fort at Pemaquid, but otherwise so incompetent that he was recalled; died in England before trial was held.

Phiva, or Thivai, modern name for Thebes, Greece; pop. 5,000: T-77-8 surrounding country G-163

Phlegethon ($fl\check{e}\check{g}'\check{e}-th\check{o}n$), in Greek mythology a river of fire in the lower world.

Phlogiston (flo-gis'ton), theoretical 'fire substance" supposed in 17th and 18th centuries to exist in combustible bodies and be lost upon combustion; theory overthrown by Lavoisier: F-45

Phlox (floks), a garden flower P-173 directions for planting table G-11 pollen grain, picture F-125

Phlox (flöks) family, or Polemonia-ceae (pöl-ë-mō-ni-d'sē-ē), a family of plants and small trees including the phloxes, cobaeas, gilias, birds-eyes, skunkweed, and Jacobs-ladder.

Phobia, an abnormal fear E-262 Phobos (fő'bős), satellite of Mars P-232

Phocion (fö'shi-ön) (died 317 B.C.), Athenian general, opponent of Demosthenes and the anti-Mace-donians, virtual ruler of Athens for a time after Chaeronaea; finally forced to drink hemlock for alleged treason.

Phocis (fő'sis), ancient district in central Greece; chief mountain, Parnassus; took part in Sacred War (357–346 B.c.) and was conquered by Philip of Macedon; contained shrine of Delphic Oracle: map G-154

Phoebe (fe'be), in Greek mythology, name given to Artemis (Diana) as a moon goddess; also, poetically, to the moon; feminine form Phoebus.

Phoebe, a bird of the fly-catcher family F-129-30

Phoebus (fē'būs), the "bright," in Greek mythology, name given to the sun god, Apollo, and also, poetically to the sun. See in Index Apollo

Phoenicians (fe-nish'i-duz) Semific race inhabiting narrow strip along Mediterranean coast of ancient Mediterranean coast of ancient Syria P-173-4, map B-8 alphabet A-134a, b, 135, P-174 arts and industries P-174

colonies P-174, C-307-8: Carthage C-88-9; Cyprus C-421; Malta M-43; Sicily S-140 exploration and commerce P-173-4,

G-34: Britain E-269, T-98

glassmaking G-101 language H-266 religion P-174

ships and navigation S-117-18, N-49, P-174, picture S-125

Phoenix (fe'niks), Ariz., popular winter and health resort in s. center; pop. 65,414; govern-ment Indian school; trade center of rich farming district created by great Roosevelt Dam; mining in-terests: maps A-289, pioture A-291 Salt River project I-149

Phoenix, fabulous sacred bird of ancient Egyptians, said to come out of Arabia every 500 years to Heliopolis, where it burned itself on altar and rose again from its ashes young and beautiful; symbol of rising sun and of immortality.

Phoenix, in Greek legend, Achilles' teacher A-8

Phoenix Islands, eight small islands
—Birnie, McKean, Phoenix, Hull,
Sydney, Gardner, Canton, and
Enderbury—south of the Equator
and east of the Gilbert Islands;
area 16 sq. mi.; pop. 62. As a group
they belong to the Gilbert and
Ellice Islands colony, but in 1938
Great Britain and U. S. made a 50year agreement for ioint control of year agreement for joint control of Canton and Enderbury islands for use as commercial air bases: map

Canton Island, picture P-10d Phoenix Park, Dublin D-115

Phoenixville, Pa., iron and manufacturing borough on Schuylkill River 23 mi. n.w. of Philadel-phia; textiles, bridges, hosiery, cement blocks, rubber; pop. 12,282.

Pholio'ta, a mushroom, color plate M-306a-b

Phonetics (from the Greek meaning to speak or to sound), a science of the sounds made in speech in English spelling S-245

Phonogram, in writing W-184-5

Phonograph, gramophone, or graphophone, instrument for recording and reproducing sound P-174-6 communication influenced by C-324a dictaphone D-67b-c disk used in talking pictures M-278

transcriptions for radio R-30 Phonog'raphy, writing by sound, basis of shorthand S-134-5

Phoreys (fôr'sis), in Greek mythology, a sea god, father of the Gorgons, the Graeae, and other monsters.

Phormio (fôr'mǐ-ō), Latin comedy by Terence first produced in 161 B.C. named from chief character, a parasite.

Phosgene (fős'ġēn), Phosgene (fős'ġēn), or car chloride, a poison gas G-25 charcoal used in making C-144

Phosphate (fős'fāt), a salt of phosphoric acid C-175. See also in Index Phosphate rock

aluminum: turquoise contains G-29 bread-making, use in B-229 calcium C-19, F-27: in bones B-172 fertilizer F-27: experiment proving need of phosphorus, picture P-235 human body content P-202

magnesium: gives hardness to bones B-172

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deposits: Florida F-112, T-7, picture F-114; Idaho I-9; Pacific Islands P-7; South Carolina S-214; Tennessee T-46

mining, ploture F-114

Phosphor (fős'fór), or Phos'phorus, name given by Greeks to morning star; same as Roman Lucifer; in Greek mythology, the son of Eos (Aurora); at first considered to be

same as Hesper, the evening star; later believed to be his brother.

Phosphor bronze A-132, B-249 Phosphorescence (fős-főr-ős'ĕns), the emission of light without sensible heat after exposure to light or other forms of radiation; term often applied to luminescence of living organisms; P-176

deep-sea animals O-198, picture O-199

fireflies F-58-9 glowworms F-58-9

luminescence distinguished P-176 Phosphor'ic acid, a compound of hydrogen, oxygen, and phosphorus (H₃PO₄); forms phosphate salts. See in Index Phosphate

Phos'phorus, a soft yellowish element that burns at a low temperature P-177, C-175, 168. See also in Index Phosphate; Phosphate rock

allotropic forms P-177, C alloyed with bronze B-249 antidotes P-177, P-275 C-169-70 bones contain as phosphate B-172

foods containing F-145 iron and steel I-144 matches M-86

plants require F-27, picture P-235 poison gas G-25

protoplasm contains B-109 red P-177 soil requires S-191b

sources P-177 white P-177

"Phossy jaw," disease once common in match industry P-177

Photius (fo'shi-us) (820?-891?), Byzantine prelate and scholar, patriarch of Constantinople, most important work is Bibliotheca!, or 'Myriobiblon', a collection of extracts from 280 works of classical authors, originals of which are largely lost.

Photoelectric cell, electric eye, or photocell P-177-9, E-241 automatic devices A-386, pictures

A-385

gas-filled type P-178 glow-lamp P-178, 179, E-242-3 oil-burner control H-265

selenium cell compared P-177-8, S-76 sound pictures ("talkies") showing M-280: projector, picture M-279 space charge E-243

vacuum type P-177-8 Photoelectric effect T-41

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potassium bichromate used in C-231 Photoflash bulb, in photography P-186 Photog'raphy P-179-86

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Photolithog'raphy, planograph print-ing, or offset E-298, L-164 Photomechanical engraving E-296-8

Photom'eter, instrument for measur-ing intensity of light L-125, B-272 Photom'etry, measurement of illumi-nation L-125

Photomi'erograph, photograph through a microscope, pictures B-204, M-157 amoeba, pictures A-188

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Photon, a quantum of light energy, A-362, R-16, R-32

Pho'tosphere, light sphere of sun S-328 Photosphere, ight sphere of san 3-320 Photospythesis, in plants, formation of carbohydrates from carbon di-oxide and water by sunlight and chlorophyll P-238, B-110-11, 112 atmospheric balance A-62 structure aids L-88, picture P-240

Photother'apy. See in Index Light therapy

Phototropism, the reaction in plants of turning toward or away from light P-241-2, 245c, L-88-9

Phrase, in grammar S-79 adjective P-342 adverbial P-342

prepositional P-342-3 Phratry (fratri), a group of clans F-11

Phrenol'ogy P-186

Phrygia (frig'i-a), ancient country of w. Asia Minor; extent varied at different periods; overrun by Cimmerlans 7th century B.C.; later ruled by Lydia, Persia, Macedon, and Rome; music and orgastic rites influenced Greeks: map G-154

Phycology, the branch of botany that treats of algae. See also in Index Algae

hycomycetes (fi-kō-mī-sē'tēz), a class of fungi resembling algae but lacking chlorophyll F-218, Outline Phycomycetes

mildews, downy and black molds M-170

Phycophyta (fi-kô-fi'tà), a phylum of plants comprising the algae, Outline B-205. See also in Index

Phyfe, Duncan (1768-1854), American furniture maker; used lyre as a favorite motif in designing delicate and graceful pieces of furni-

I-106, F-222, piotures furniture T-101, 103

Phylloxera (fil-öks-ē'rā), or grape aphid, an insect parasite G-135, G-163

Phylogeny (fi-löj'é-ni), evolutionary history of a biological group

plants B-203 parallels rehearsed in animal em-bryos E-341

Phy'lum (from the Greek, meaning tribe), a major division in biological classification B-116

Physic, or laxative, a medicine H-372 Physical chemistry, covers border line between physics and chemistry C-166, 179

atoms and electrons A-360-2 catalysis C-171-2 colloids C-302-3 electrochemistry E-239, E-224-6

gases, ionization E-239 Physical examination, importance H-372

Physical geography. See in Index Physiography

Physical training P-186-7. See also m Index Athletics; Sports ancient Greece E-168, 169; sculpture influenced by G-165

child development and C-199, pictures C-201, 202 folk-dances F-132-5

hygienic value of exercise H-376 Japan's system W-183 kindergartens K-17-18 play materials ald P-258 posture, correct, pictures P-187 violent exercise harmful H-259

Physician, work of M-108-9 training, internship H-345 Physician's Tale, in 'Canterbury Tales'

Phys'ics, science of matter and energy P-188-97, Outline P-196-7. See

also in Index principal topics listed below atoms A-360-2

bibliography P-197, H-313i chemistry, relation to C-166, 179 color C-308e-j

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heat H-259-63, P-194 history P-196 light (optics) L-125-31

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matter, forms and properties P-189-90, R-15: colloidal C-302-3 mechanics M-103-6, P-190-3 "new physics" P-194-6 Nobel prize winner

Nobel prize winners N-148, 149 photoelectric P-177-9 devices cell and

radiation R-13-16 radium and radioactivity R-32-5 relativity E-211-13 theory of Einstein

sound (acoustics) S-194-8, P-193-4 thermodynamics (study of heat) P-194

wave motion W-57-8 X-rays X-198-202

X-rays X-198-202

Physiocrats (fis'i-ō-krāts) (from the Greek, meaning rule by nature), followers of the social and economic doctrines of François Quesnay (1694-1774). They held that true wealth ("surplus value") derived solely from the simple products of nature obtained by agriculture, mining, fishing, etc., and that manufacturing, which merely changed the form of raw materials, was in itself sterile. They held that the state should not interfere with man's exploitation of nature ("laissez-faire") and originated the

theory of the "single tax" on land and rents.

Physiognomy (fiz-i-ŏg'nō-mi), art of reading mental and character traits by bodily formations, espe-cially by features of the face; of ancient origin; treated by Aristotle; now considered a pseudoscience.

Physiog'raphy, or physical geogra-phy, the science dealing with the phy, the science dealing with the form and attributes of the earth's surface P-197-202, map G-32-3, Outline G-35-7. See also in Indew Air; Earth; Climate; Geology; Rock; Soil; Water; Winds; also features of the earth, as Lakes; Mountains; Rivers; and names of centirents. continents

geography related P-197 geology related G-39

Physiolog'ical chemistry B-109-10 Physiology P-202-7, B-115-16, Outline P-207-9, See also in Index Anatomy; Biology; Hygiene; and chief subjects listed below

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cell, unit of body structure C-122 child development C-197-9 defined P-202

digestion D-68-9, pictures P-204-5: enzymes E-298-9; pepsin P-120; stomach S-292 emotion affects body E-262

energy, production B-110 excretion B-110: kidneys K-16; skin

S-156-7 glands and their work G-99-100: liver L-165

habits H-193 hormones G-99-100 light, chemical effects L-131 lymph and lymphatic system P-206 metabolism B-110 metals in body M-123 muscles M-304-5, B-110 nervous system N-64-5: brain B-219-24; sympathetic nerves

P-207

organs and their functions P-202-7 oxidation B-110, O-261-2 plant P-207, B-203, 205, Outline B-206: processes P-257-44, 245e-i protoplasm B-115: colloidal nature

B-109-10 reflexes R-63-4, B-221-2, 223 respiration R-79-80: lungs L-219 sensation and perception S-76-8 hearing: ear E-126-8; sound per-ception S-196

sight: eye E-349-52; color perception L-129-30 smell S-164 taste T-16: tongue T-107

touch T-116-17

sleep S-162-3 voice V-330-1 water in body: function W-42a; proportion W-42 work and fatigue W-147-8

work and fatigue w-147-8
Physostegia (fi-sō-stö'fi-d), or false
dragonhead, a genus of perennial
plants of the mint family, native to
N. America. Grows to 4 ft., forming
clumps; has spikes of small purple
flowers. Common false dragonhead
or obedient plant is P. virginiana;
lion's heart is P. denticulata.

Northelagollata group of unicellular

Phy'toflagella'ta, group of unicellular animals containing chlorophyll. often considered plants (Volvocalee)

Phytolaccaceae (fi-tō-lă-kā'sē-ē). See in Index Pokeweed family

Pi (ni), a Greek letter (written π) used as symbol in geometry G-47

Piacenza (pē-yā-chēnt'sū), fortified town in n. cent. Italy on Po River; pop. 62,000; founded by Romans as Placentia 218 B.C.; a leading town of Lombard League in Middle Ages.

Pia mater (ni'à mä'ter), of brain B-219 Pinnkashaw (pi-ăn'kā-sha), Indian tribe of Algonquian stock, once a branch of Miami; controlled lower Wabash Valley.

(pē-ä'nō), nianoforte Plane P-209-13, M-321 concert pitch S-197

international pitch S-197 Jankó keyboard P-212

keys, black and white, reason for S-108

musical development promoted by P-213, B-10 notes and octaves P-211, diagram S-198

pitches of notes S-196, 198, P-213

player-plano P-212 range of notes S-198, P-211 strings P-210-12, S-196 tuning P-213

Piano, in music, soft in tone; pianissimo, very soft.

Piano accordion, a musical instrument M-323

Planofor'te P-210. See also in Index Piano

assava (pē-ë-së/vë), fiber from a palin grown in Brazil (Attalea funifera) and Africa (Raphia vina-Piassava fera); used in making ropes, sails, mats, and brushes; African plassava inferior to Brazilian; other fibers also known as piassava.

Piaster (pī-ās'tēr), a coin formerly worth about 47 cents in French Indo-China, about 5 cents in Turkey and Egypt, 8 cents in Syria; now the monetary unit of Turkey, nominally worth 4½ cents.

Platigorsky (pē-āt-ē-gōr'skē), Gregor, (born 1903), Russian cellist; appeared in concerts in Russia at age of 9; later made tours throughout Europe, and from 1929 in America.

Plaulty (pē-ü-wē), Brazīl, state, touching n. seacoast; 94,819 sq. ml.; pop. about 900,000; cap. Therezina; rice, skins, cotton, tobacco.

Plave (pē-yā'vā), river of n.e. Italy; rlses in Carnic Alps and joins Adriatic 20 ml. n.e. of Venice; length 180 ml.; map I-156 in 1st World War W-162, 164-5

Plazzi (pē-yūt'sē), Gluseppe (1746– 1826), Italian astronomer, discov-erer of first asteroid (Ceres) A-339

Picabla (pë-kä'byä), Francis (born 1879), French artist, born Paris; worked first as impressionist, later as cubist, and then became one of leaders of dadaism.

Pic'ador, in bull fighting, a horseman with a wooden rod tipped with steel, called a "pica," with which he torments the bull.

Picardy (pik'ar-di), old province of n. France; contained towns of Amiens (cap.) and Boulogne, and battlefields of Agincourt, Creey, Saint-Quentin: map F-179 World War battle 1918 S-193

Picaresque (pik-a-resk') novel N-181 Picasso (pē-kā'sē), Pablo (born 1881), Spanish painter, born Malaga; lived in Paris; one of leaders of post-impressionist school; pioneer in cubism; reverted to naturalism, but later turned to extreme abstract painting.

Pi'ca type T-172

Pic'cadilly Circus, London L-189

Piccard (pē-kār'), Auguste (born 1884), Belgian physicist, noted for balloon ascents into the strato-sphere B-22

Piccard, Jean WATER (born 1884) Belgian chemical and aeronautical engineer, twin brother of Auguste; became U. S. citizen 1931; most noted for researches in explosives.

Pic'colo, a small flute W-135 range of, diagram S-198

Piccolomini (pēk-ko-lo'mē-nē), riccolomini (per-Ko-lo me-ne), Otta-vio, Prince (1599-1656), duke of Amalfi, born Florence; general in Thirty Years' War; in German Im-perial and Spanish service; at-tained rank of field marshal; while in Wallenstein's army was instru-mental in effecting this general's downfall by joining in a conspiracy against him; made a prince 1650.

Picea (pis'ē-d), the spruce genus of trees S-264

Picher, Okla., lead and zinc mining town in n.e. of state; pop. 5848.

Pichincha (pē-chēn'chā), volcano on w. slope of Andes near Quito, Ecuador (highest peak 15,918 ft.); battle between revolutionary patriots and Spaniards which freed Ecuador was fought on its slopes May 24, 1822.

Pichola $(p\vec{e}-ch\vec{o}'l\vec{a})$, lake in native state of Udaipur, India island palaces I-41

Picidae (pis'i-dē), the woodpecker family W-134

Piciformes (pis-i-fôr'mēz), an order of sharp-billed birds, comprising woodpeckers, flickers, sapsuckers, toucans, barbets,

Pickens, Andrew (1739–1817), American soldier, born Paxton, Pa.; brigadier general of South Carolina troops in Revolutionary War; distinguished himself at Cowpens and Eutaw Springs; member of South Carolina legislature, 1783-94 and 1801-12; in Congress 1793-95.

Pick'ens, Francis Wilkinson (1805-69), American statesman, extreme advocate of states' rights; as governor of South Carolina (1860-62) demanded surrender of Fort Sumter and ordered erection of artil-lery batteries which caused its surrender.

Pick'erel, pike, or jackfish, a food fish P-218, F-68, table F-74

Pickerel weeds, or pondweeds W-49 Pick'ering, Edward Charles (1846ck'ering, Edward Charles (1919), American astronomer, born Tim-Boston; great-grandson of Tim-othy; devoted particular attention to the study of light and spectra.

American statesman, born Salem, Mass.; member of "Essex Junto" and Hartford Convention; as secretary of war (1795) established. Pickering, West Point Military Academy.

Pickering, William Henry (1858-1938), American astronomer, brother of Edward C., discovered Phoebe and Themis, 9th and 10th satellites of Saturn; did eminent work in planetary photography and photometry

Pickersgill, Mary Young, flag maker; in 1814 made the flag which in-spired Francis Scott Key to write the 'Star Spangled Banner'; made banners and pennants for the clip-per ships of Baltimore.

Picket, in strike L-44c

Picketing, the practise of trade unions of placing watchers near the en-trance of factories or other places of employment to dissuade non-union workers from accepting employment during a strike.

Pickett. George Edward (1825-75), American Confederate general, horn Richmond, Va. defeated at Five Forks S-115

Gettysburg G-81, map G-81

Pickford, Mary, stage name of Gladys Smith (born 1893), American motion-picture actress, born Toronto. Canada: made stage début at 5: later appeared in David Belasco productions: turned to motionproductions; turned to motion-picture work and rose to high rank; married Douglas Fairbanks 1920, divorced 1935; married Charles (Buddy) Rogers 1937 ("Tess of the Storm Country'; 'Cinderella'; 'Daddy Long Legs'; 'Coquette').

Pickles, made from cucumbers C-413 Pickthall, Mariorie Lowrey Christie (1883–1922), Canadian poet and novelist, born in England; best known for poetry ('Drift of Pin-ions'; 'Wood Carver's Wife'; 'Anions'; 'Wood Carver's Wife'; 'A gel's Shoes', short stories): C-66

Pickwick Papers', novel by Dickens D-66-7, 65, 67a

Pico, mountain opposite Sugar Loaf on harbor of Rio de Janeiro.

Pic'ric acid, a yellow, crystalline, organic acid, used in manufacture of explosives E-348 structural formula C-176a

Pictograph, in ancient times W-184, charts W-185

Pictographs (Isotype), visual educa-tion devices developed (1925-1934)

by Otto Neurath, sociologist of Vienna G-136a-e agriculture, effect of use of machinery A-50

altitude and vegetation E-145d animals, average ages A-198 automobiles in U.S. and other countries G-136b-c

birth and death rates of various countries P-304b

Canada, occupations C-50a carbon and nitrogen cycles P-238a, b China: area and population compared with U.S. C-213

European countries and their colonies E-322a

Great Lakes shipping G-149 health-conquest of disease H-255-6 heart and circulation H-258a heat, molecules in motion H-258b heredity-Mendel's law H-283a, b

Industrial Revolution, effects of I-74e, f, k, m, n, o international trade I-110e-f Japan: compared with California J-186a: growth of commercial power J-186b

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tools, development of T-110a transportation, water, improvement over Roman days T-120 United States

automobile production G-136b-c Great Lakes shipping G-149 Industrial Revolution, effect of

I-74f, k, m, n, o international trade U-197 merchant marine S-128b occupations U-188d

population: area and F-304b, compared with China C-213; area, pared with China C-213; area, products, and, compared with rest of world U-188a; movement from country to city I-74f; states in 1930 G-136d

water power W-50 vegetation and altitude E-145d wheel, development W-84a, b work and leisure I-740

Picts, people of disputed origin early inhabitants of Scotland S-45-6 invade Britain E-270 Shetland Islands S-116

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Aztec, pictures A-409, 410 Indians I-62-3, pictures I-63, C-245 Pid'dock, a boring mollusk, picture S-108

Pidgin (pij'in) English, or Pigeon English, a jargon consisting chiefly of corrupted English words used in communicating with Chinese in Chinese ports and the Straits Set-tlements; pidgin from Chinese cor-ruption of word business.

Pie, a copper coin of India I-38

Piece of eight, popular name, in English-speaking colonies of Amer-ica, for the old Spanish silver dollar or peso, which was marked with the figure 8 to indicate that it was worth 8 reals.

Pie chart, or circle graph G-136e-f Pied-billed grebe, dab-chick, or hell-diver G-151, picture B-127, color plate B-133

foot, picture B-129

Piedmont (pēd'mont), division of n.w. Italy; comprises provinces of Turin, Novara, Alessandria, and Cuneo; 11.335 sq. mi.; pop. 3,546,-000; cap. Turin: I-161, T-157 Napoleon I annexes N-8

nucleus of United Italy S-29, I-157-8: Cayour C-120; Garibaldi G-15; Victor Emmanuel II V-294

Pledmont region, a name (means "at the foot of the mountains") used for that part of the Atlantic coast plain between the Appalachian Mts. and the Coastal Plain G-31

Alabama A-96, 98b Georgia G-55 Maryland M-76 North Carolina N-156 Pennsylvania P-112 settlement A-161 South Carolina S-212 Virginia V-303-4

Pled Piper of Hamelin, magician in German legend who, by his piping, charmed the rats of Hamelin into following him into the river; because he was not paid he lured the children of the city away; story used by Browning in poem.

Pieplant, or rhubarb R-100-1 when and how to plant G-13 Piepowder courts F-3

Pier, a projecting structure in nav-igable waters H-217, picture H-216 Pier, in architecture, a vertical sec-

Pier, in architecture, a vertical section of masonry which supports a superstructure, picture A-249
Pierce, Franklin (1804-69), 14th president of U. S. P-213-14 administration (1858-57)
American (Know Nothing) party

P-292

border warfare in Kansas K-7, B-250 Brook's assault on Sumner S-326 Jefferson Davis, secretary of war

D-19 Gadsden Purchase U-241-2, map II-242

Kansas-Nebraska Act K-7, P-214 Ostend Manifesto C-250-1 Perry's treaty with Japan J-184 Republican party formed P-292 friendship with Hawthorne H-249 Mexican War service P-214

wife W-91

Wife W-91
Pierce, Jane Appleton (1806-63), wife of President Pierce W-91
Pierce, John Davis (1797-1882), American educator, born Chesterfield, N. H.; member of Michigan state legislature 1847-48 founded Michigan school system

M-155

Pierian (pī-ē'rĭ-ān) Spring, in Greek mythology, fountain of the Muses in Pieria, a region of Macedonia; supposed to give those who drank poetic inspiration.

Pierpont, Francis Harrison (1814-99), American political leader, born Monongalia County, Va. (now West Virginia); organized convention Virginia); organized convention which decided western part of Virwhich decided western part of virginia should remain loyal to Union during Civil War, and was provisional governor of the section, which became the state of West Virginia; served in West Virginia

virginia; served in West Virginia legislature 1868-70.

Pierre (pēr), S. D., cap. of state, on Missouri River, in farming and natural gas region; pop. 4322; cattleshipping interests; government industrial school for Indians: S-218, man S-218. man S-218

Pierrot (pē-yêr-ō'), idealized clown in French pantomime, similar to Italian Harlequin.

Piers Plowman, chief character in 'Vision of Piers Plowman', early English allegorical poem attributed to William Langland.

'Pietà' (pē-yā-tä'), of Michelangelo, nicture M-148

(pētēr-mä'rĭts-Pietermaritzburg bûrg), cap. of Natal, 40 mi. n.w. of Durban; pop. 50,000 (including 28,000 Europeans): map A-42a Piezo-electric crystal (pi-ē'zō) clocks W-41

radio R-26

supersonic waves S-196 Pig. See in Index Hog

igafetta (*pē-gā-fēt'tā*), Antonio (1491–1534?), Italian chronicier of Magellan's voyage M-28 Pigafetta

igalle $(p\bar{e}-\bar{g}\bar{a}l')$, Jean Baptiste (1714-85), French sculptor, noted for monumental sculpture and realistic busts and portraits; his mas-Pigalle terpiece, Mercury Attaching Wings to His Feet', is in Louvre, Paris. Pig deer, or babirussa, long-tusked wild swine found on the island of Celebes.

Pigeon berry. See in Index Pokeweed Pigeon Creek, home L-140 Indiana, Lincoln's

Pigeon milk P-215

Pigeon River, stream forming part of boundary between Minnesota and Canada, map M-192

Pigeons and doves P-215-16, pictures

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dodo a relative D-75 domestic breeds P-215-16: pets, care

of P-156, P-216
homing pigeon A-202, P-216, picture
P-217; 1st World War P-216
mourning, or turtle, dove P-215, picture N-33, color plate B-135
parasite, picture P-69

passenger pigeon P-215, B-145a

Pigfish, group of food fishes related to the grunts; excellent pan-fish of world-wide distribution.

Pig iron I-138, 146 production, annual I-145 Pigment, coloring matter algae A-120 algae A-120 chrome C-230-1 cobalt C-290 colors C-308b: mixing C-308f, g, color plate C-308g feathers F-21, B-131 paints P-32 skin S-157: effect of ultra-violet rays

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Pigmy, or pygmy, unusually small peoples P-218. See also Dwarf Africa P-218, A-40, picture A-35: racial affinity, diagram R-9b Andaman Islands I-43

Philippines P-165: forms of mar-riage F-8

Pigmy elephant, or round-eared ele-phant E-248, 250, picture E-246 Pigmy rattlesnake. See in Index Ground rattlesnake

Pigmy shrew M-217 Pigmy whale W-78

Pig-nut, a hickory H-291

"Pig's Eye." See in Index Parrant. P. Pigskin, skin of pig or hog, also the leather made from it; used for belts, gloves, purses, saddles, bookbindings.

Pig-sticking, or boar hunting B-160 Pig-tail monkey, picture M-226

Pigtails, or queues China C-216, picture C-217 18th-century dress D-107, 109

Pig weed, a coarse persistent weed of the goosefoot family, growing from 2 to 3 ft, high, with spikes of small greenish flowers.

Pi'ka H-223

lke, Zebulon Montgomery (1779– 1813), American general and ex-plorer, born New Jersey; surveyed upper Mississippi in 1805, bringing Pike. back valuable information; in 1806 explored the Arkansas River and was first to view mountain called for him Pikes Peak; detained in Mexico for trespassing on Spanish soil; made brigadier general in War of 1812, and was killed while leading the attack on York (now To-

ing the attack on York (now Toronto), Canada explorations F-14, S-222, map U-242: Colorado C-314; Iowa I-119; Minnesota M-194, S-11
Pike, pickerel, or jackfish, a food fish P-218, F-68, table F-74
Pike National Forest, Colo., picture

Pike-perch, or walleyed pike, an ex-

cellent food and game fish (Stizostedion vitreum); found in U.S. east of throughout region Missouri River: P-218

Pikes Peak, famous peak of Rocky Mts. near Colorado Springs, Colo.; Mts. hear Colorado Springs, Colo., 14,110 ft; discovered 1806 by Zebu-lon M. Pike: map C-310 immigrant trail C-312 vegetation R-123

Pikes Peak Highway R-114

Pilaf (pē-löf'), also pilau (pē-lou'), a Turkish dish G-163

(pī-lā'nī), in Roman Legion Pilani . A-307/

Pilaster (pi-läs'ter), in architecture, a column partially projecting from a wall, usually finished with a capital.

Pilate (pilat), Pontius (first century A.D.), Roman governor of Judea, who gave up Jesus to be crucified J-214

Pil'chard, the true sardine S-28

Pilcomayo (pēl-kō-mā'yō) River, rises in Bolivia, flows 1000 ml. from the Andes to the Paraguay River; forms part of n. boundary of Argentina: A-280, maps A-279, S-208b-c

Pile, in building, a heavy beam driven into soft ground to form part of foundation B-264

Pileated (pī'lē-āt-ēd) woodpecker, W-135, picture W-134

Pile driver T-110

Pil'grimage of Grace, insurrection in England (1536) H-278

Pilgrim Fathers, founders of Plymouth Colony M-91-4, P-261-3 financing Plymouth Colony A-152 first Thanksgiving T-74, picture first Th

hardships A-153

list of Pilgrims M-92, 94

'Psalm Book' M-316 Separatist branch of Puritans P-369 shelter, picture P-262

signing the Mayflower Compact, picture M-93

Miles Standish S-270 treaty of peace with the Indians

P-261 use of water power W-49

Pilgrims P-219

Asia, pilgrimage centers in A-332 Benares mecca of Hindus B-94-5 Canterbury C-77, B-72: Chaucer's Canterbury Tales' C-161-2, pio-tures C-160, 161, 162 Crusades aid C-403, 406 Mohammedan or Haj M-103, pictures

M-102

scallop shell emblem S-36

'Pilgrim's Progress', allegory by John Bunyan B-274, 275, E-285 relation to novel N-181

Pilica (pē-lēt'sā) River, Poland, tributary of Vistula.

Pillar, in architecture. See in Index Column

Pillar saints. or stylites. chiefly of Syria and Palestine (5th to 12th century) who lived on tops of pillars. Simeon Stylites of Antioch was most noted.

Pillars of Hercules, in ancient geography, the two promontories, Calpé (Gibraltar) in Europe and Abyla in Africa, at e. extremity of Strait of Gibraltar: G-86

legendary origin H-282

Pill boxes, machine-gun nests in 1st World War A-282, picture W-163

Pillorn, name for oats O-191
Pillion, a seat back of a riding saddle; name applied also to the saddle for a passenger on a motorcycle T-122 pioneer life T-122

Pillory, instrument of punishment. pioture A-162 in Delaware P-349

Pillow lace, or bobbin lace L-47, piotures T-49

Plinyak (pilm-ydk'), Boris (born 1894), pen name of Boris Andree-vich Vogau, Russian short story writer and novelist ('The Naked Year'; 'Machines and Wolves') place in Russian literature R-197

Pilon (pē-lôn'), Germain (1535?-90), French sculptor, of the late Renaissance; his sepulcher for the heart of Henry II, now in the Louvre, and the two-story tomb of Henry II are among his finest works; medallions, medals, and coins among finest of his time; worked in marble, stone, wood, terra cotta, and bronze.

Pilot blacksnake, a rat snake S-172 "Pilot bread" B-232

Pilot 'chute P-62, pictures P-62, 63 Pilot-fish, a species of fish (Naucrates ductor) found in tropical and subtropical seas; average length 12 inches, silvery gray-blue in color with 5 to 7 darker bands around body; often follows ships; its name comes from its habit of swimming ahead of sharks: A-233 Pilot Knob, hill in Missouri O-266

Pilot snake, or copperhead C-361, pioture S-170

a pit viper V-302-3

Pilot whale, or blackfish, a member of the dolphin family W-77, 80

Pilsen (pří'zěn), Bohemia. See Plzen Pilsudski (pēl-sud'skē), Josef (1867-1935), first president of Poland and commander of army P-279

Piltdown skull M-46

Pima $(\eta \bar{e}'m\dot{a})$, a tribe of Indians living on the Gila River and Salt River reservations in Arizona; skilled in agriculture, weaving, pottery making; Casa Grande Park is in their territory: I-55 houses I-60

Pima cotton C-382

Pimento, allspice, or Jamaica pepper S-249, 250, P-120, picture S-251 Trinidad tea from leaves T-27

Pimiento (pē-myěn'tō), a sweet red pepper P-119

Pim'pernel, a low spreading plant (Anagallis arvensis) of the primrose family with branching stem, opposite leaves, and blue, scarlet, or white flowers; also called shepherd's-clock and poor man's weather glass because at the approach of rain it closes its petals. Pin P-219

Piña (pēn'yā) cloth P-221

Pinafore, H. M. S.', comic opera, words by W. S. Gilbert, music by Arthur Sullivan; first produced 1878; much of action takes place on deck of the ship *Pinafore* in the harbor of Portsmouth, England.

Pinakothek (pin'a-kō-thēk or pē-na-kō-tāk'), Old and New, museums in Munich M-801

Pince-nez (pans-na'), eye-glasses S-240

Pincers, a tool T-110

Pincers attack, in warfare

Meuse-Argonne battle (1918) A-282; Pollsh Campaign (1989) W-178d; Battle of Flanders and France (1940) W-178h-4.

Pinchbeck, a gold imitation A-133 Pinchet (pin'shō), Gifford (born 1865), American forestry expert and pioneer conservationist, born Simsbury, Conn.; studied forestry in Europe; head of U. S. forestry

activities 1898-1910; became president National Conservation Association 1910; active supporter of T. Roosevelt; negotiator of coal strike settlement 1923; governor of Pennsylvania (1923-27, 1931-35) Taft dismisses T-3

Pinckney (pink'ni), Charles (1758–1824), American statesman, governor of South Carolina 1789–92, 1796–98, 1806–08; member of Constitutional Convention; as minister to Spain (1802–05) he secured renunciation of Spanish claims to Louisiana Territory

in Constitutional Convention U-208 Pinckney, Charles Cotesworth (1746-1825), American statesman, born Charleston, S. C.; member of Con-stitutional Convention; minister to France 1796-97; unsuccessful candidate for vice-president (1800) and president (1808) 'X Y Z' negotiations X-202

Inckney, Thomas (1750–1828), American soldier and politician, born Charlestown, S. C.; brother of Pinckney, Charles C. and cousin of Charles; served in American Revolution; governor South Carolina; minister to Great Britain; on special mission to Spain; member of congress; major general in War of 1812 treaty with Spain W-18

Pincushion flower. See in Index Scabiosa

Pin'dar (518-446? B.C.), Greek lyric poet, master of "the grand style in simplicity" G-172 Alexander spares his home A-114

Pindar'ics, loose and irregular odes, in imitation of Pindar, fashionable in England at close of 17th and beginning of 18th century.

Pin'dus Mountains, main range of Greece running from n.w. to s.e.; source of principal rivers in Greece: maps B-18, E-318a

Pine, a cone-bearing tree found chiefly Northern Hemisphere P-219-21

in Northern Hemisphere P-219-21 conserving forests, picture E-145h diseases and pests: blister rust R-199, C-414, picture R-200 distinguished from other conifers P-221: spruce, picture S-264 Norway forests N-178

paper source P-61, P-220, P-245b-c species P-219-20 swamp forests W-49

turpentine T-165-6 United States

forests P-220-1. F-154-5 Alabama A-98

annual cut U-194 Georgia G-55, 56, picture G-57 Idaho I-9 Louisiana L-206, picture L-205 South Carolina S-213-14

Texas T-54

Washington W-29 wood-tar T-12 Pincapple P-221

Florida F-111, P-221 Hawaiian industry H-241, 243, P-221, picture' H-242

Pineapple family. Bromelia family See in Index

Pine-beetle, name given to bark-boring insect which attacks pine and other coniferous trees; belongs to family Scolytidae: F-155

Pine Bluff, Ark., industrial city on Arkansas River 38 mi. s.e. of Little Rock; pop. 21,290; cotton, lumber, and iron products; railroad shops; and fron products; rainroad snops; Agricultural, Mechanical and Nor-mal College (Negro); damaged by Confederate artillery (1863) in un-successful attack upon Union forces: map A-296

Pine Bluffs, Wyo., village in s.e. corner on Lodgepole Creek 38 mi. e. of Cheyenne; pop. 771 end of cattle trail C-112

Pineda (pē-nā'dā), Alonso Alvarez de, Spanish explorer; sailed along north shore of Gulf of Mexico in 1519

along Texas coast T-59 route, map F-111

Pine family, or Pinaceae (pī-nā'sē-ē), a family of shrubs and trees, native chiefly to temperate regions, including the pines, firs, dammar-pines, araucarias, cypress-pine, cypress, cedars, China-fir, junipers, larch, incense-cedar, spruce, golden-larch, douglas-fir, sequoia, arar-tree, douglas-fir, sequoia, arar-tree, arborvitae, and hemlock. Pine grosbenk G-178, 179

Pine Hill Divinity Hall (formerly Presbyterian College), Halifax, Nova Scotia; United Church of Canada; men; theology; established 1820; affiliated with Mount Allison and Dalhousie universities.

Pinchurst, N. C., noted winter resort 62 mi. s.w. of Raleigh in "Sand Hill" region; golf tournaments.

Pine marten, American, or Canadian sable M-72

Pine Ridge Reservation, S. D. S-218 Pinero (pi-ner'ō), Sir Arthur Wing (1855-1934), English playwright, born in London, of Jewish-Portuskilful dramatic guese parents; skilful dramatic craftsman; acted on stage in youth; Knighted 1909 ('The Second Mrs. Tanqueray'; 'Trelawney of the Wells'; 'The Gay Lord Quex'; 'Iris'; 'Letty'; 'Mid-Channel').

Pines, Isle of, fertile island belonging to Cuba, about 40 mi. s. of western end of Cuba; 1180 sq. mi.; pop. 5000; cap. Nueva Gerona: map C-412

Pines, Isle of, small island in s. Pacific, 30 mi, s. e. of New Caledonia of which it is dependency; 58 sq. mi.; map P-10b

Pines. The, in New Jersey N-89

Pine tree emblem

Bunker Hill flag F-99, color plate Continental flag, 1775-77 F-98, color

plate F-90 Linked Hands flag F-98, color plate F-90

Maine flag F-91, color plate F-87 New England ensign F-98, color plate F-90

Vermont flag F-93, color plate F-87 Washington's cruisers F-99, color plate F-90

Pine tree money, money coined in Massachusetts, 1652-82, which had massachusetts, 1052-82, Which had a pine tree on one side and the name New England with the date on the other; coined in values of shilling, sixpence, and threepence. Pine Tree State, popular name for

Maine M-38 Ping pong, a form of tennis played indoors on a table (regulation table 9 ft. long by 5½ ft. wide); lightweight bats shaped like a tennis racket and celluloid balls are used.

Pingyang, Korea, also Heijo, walled city 40 mi. from w. coast: pop. 180,000; great strategic importance: map A-332b

Pink, a flower P-221 carnation C-85

Pink azalea, or pinxter flower A-408 Pin'kerton, William Allan (1819-84), American detective, born Glasgow, Scotland; organized (1861) federal secret service and founded a famous private detective agency.

Pink family, or Caryophyllaceae (kurt-ō-fi-lā'sē-ē), a family of plants, including the carnation, gypsophila, mouse-ear chickweed, sweet William, bouncing bet, starwort, and sandwort.

Pinking, in sewing S-88, diagram S-89 Pink ladyslipper L-53

Pink root, or worm-grass, a perennial herb (Spigelia marilandica) of the logania family with opposite leaves and showy flowers, red outside and yellow within, spiked in a onesided cyme; root used medicinally as a vermifuge.

Pink salt C-177 Pinna, of ear, diagram E-127 Pinnacles, national monument in California N-22c

Pin'nated grouse, or prairie chicken G-181

Pin'nate leaves L-89

Pln oak, bur oak, or over-cup oak O-189, 190

'Pinocchio' (pē-nôk'yō), a story of the adventures of a wooden puppet by C. Collodi (Carlo Lorenzini): picture L-112

Piñon tree. See in Index Pinyon tree Pinscher (pin'shēr), a muscular dog with terrier and German shepherd blood D-83

Pinsk, city in Poland; pop. 40,000; on the Pripet River, 105 mi. e. of Brest-Litovsk: map E-326e

Pint, a unit of measure, table W-67 'Pin'ta', one of Columbus' vessels C-318

Pin-tail duck, picture D-117 trap, picture B-145a

Pinto (pēn'tō), Fernão Mendes (1509-Portuguese adventurer: companion of Francis Xavier on mission to Japan; his account of un-known Japan, long regarded as a sort of Munchausen yarn, is now conceded to contain much truthful description besides possessing literary value.

Pintsch gas, an illuminating gas G-23 Pinturicchio (pēn-to-rēk'yō) ("little painter"), "easel name" of Ber-nardino di Betto (1454-1518), Italian artist, one of the outstanding painters of Umbrian School, 'The Dispute of Saint Catherine' and the frescoes in the cathedral library at Siena are typical works.

Pi'nus, pine genus of trees P-221 Pinwheels, revolving fireworks F-60

Pin'yon tree, or pinon tree, a nut-pine of s.w. U. S. P-220

Pinzén (pēn-thôn'), family of Span-ish navigators, 3 of whom, Martin Alonzo. Francisco, and Vicente Alonzo, Francisco, and Vicente Yañez (brothers), were compan-ions of Columbus in discovery of America

Vicente discovers Brazil B-227, map A-143

Piom'bo, Sebastiano del. See in In-dex Sebastiano del Piombo

Ploneer life in America P-221a-1; U-238-9. See also in Index Colonial

life; Far West; Southwest American Colonies A-152-3 amusements P-221*f*, U-239 bibliography P-221*l*, U-255, 256 Boone B-192

communication P-221k customs and ideals P-221d, e, f-g, U-238-9

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farmer, the real pioneer A-48-9 Far West F-15-17, P-221g-i: cattle ranches C-107-15 forests cleared U-185, picture U-239 fur traders pave way for settlers F-223-7, U-184
geographic influences on settlement

U-183-5, N-150-1 gold rush of '49 S-1, C-34-5 government U-236, 239, P-221g houses P-221c, i, pictures P-221c, i, U-238

Indian problems P-221k-l Kentucky K-11, P-221b-c land uses L-61a-b New England sugar camp M-57 North Dakota N-165 Northwest Territory P-221c-f Ohio O-209-10, 214 Oklahoma O-219

oxen C-101 religion P-2210-d. U-239 roads R-112

South Dakota S-220 Tennessee T-48, P-221c trails F-15-17, T-126

Indiana I-47-8

transportation P-221i-j, T-122-6: canals T-125; covered wagons canals T-125; covered wagons P-221g-h; ocean transport T-125; pony express T-126; river routes P-221e, j, M-206, T-125, picture P-221f; stage-coach T-124; western trails T-126

Virginia V-308 western plains P-221*g-i*, C-107-15 West Virginia W-74-6

women P-221d, e, picture P-221b Pioneer National Monument Project, in Kentucky N-22c Ploneers' Day H-321

Pioneer tunnel T-153

Pipe, tobacco briarwood H-263 Iroquois Indian, picture I-57 meerschaum M-110

oriental hooka, picture P-131
Pipefish family, the Syngathidae; includes pipefishes (long slender fishes with tubular snouts) and sea-

horses S-67 Pine lines, cross-country pines used for transporting fluid substances gasoline P-151

interstate commerce control I-112

maple sugar grove M-57
maple sugar grove M-57
natural gas G-24: Texas T-54; West
Virginia W-77
petroleum P-151, picture P-152: first
I-116; Iraq I-123; Rockefeller develops R-122; Texas F-161, H-346;
West Virginia W-77

Pipe of peace, or calumet, of North American Indians; tobacco-pipe with stone bowl and long reed stem ornamented with eagle's feathers: I-57

Pipe organ O-248-50, pictures O-248, 249, M-322

tone production S-197, O-248-50 Piper, Edwin Ford (1871-1989), poet and educator, born Auburn, Neb.; and educator, born Auburn, Neb.; professor English, State University of Iowa after 1917 ('Barbed Wire and Wayfarers'; 'Paintrock Road').

Piperacene (pip-ër-d'sē-ē). See in In-

dex Pepper family Pipes of Pan, or syrinx, musical in-strument W-135, picture M-322 forerunner of pipe organ O-250

Pipe Spring National Monument, in Arizona N-22c-d

Pipestone National Monument. in Minnesota N-22d

See Dutchman's pipe Pipe vine. Pip'it, a titlark T-99, color plate B-139

Pippa (pēp'pä), in Browning's poem 'Pippa Passes', a little Italian mill girl whose songs on her one hollday of the year unconsciously in-fluence several hearers to choose good instead of ill at momentous crises in their lives.

Pippin. See in Index Pepin

Piqua (pik'wd), Ohio, industrial cen-ter on Miami River and Miami and Eric Canal, 70 mi. n.w. of Columbus in farming section; pop. 16,049; underwear, hosiery: map O-210 Piqué (pē-kā'), a heavy cotton cloth with corded surface.

Pique gloves G-107

Pinue gioves G-107

Pinueus (pi-re'ús), Greece (Greek, Peiraleus), seaport for the city of Athens, and 5 mi. s. w. of it; pop. 250,000: A-355, maps B-18, E-326e ancient fortifications and A-353: destroyed G-181 harbor, picture H-217

Phondalla (-5.2.2.4 2007)

randello (pē-rün-dēl'lō), Luigi (1867—1936), Italian dramatist and novelist, born Girgenti, Sicily; best Pirandello known for plays dealing with prob-lem of reality and illusion in human lem of reality and illusion in human life ('Six Characters in Search of an Author'; 'Right You Are If You Think You Are'); also wrote short stories and novels ('The Late Mattia Pascal'; 'Shoot'); won Nobel prize for literature 1934: D-96 iranes! (pē-rā-nā/zē), Giovanni Battista (1720-78), Italian engraver; noted for engravings and etchings of ruins of Roman buildings and for imagined architectural creations—massive arches, great

Piranesi . creations—massive arches, great stairways, and columned structures dotted with shadowy figures.

Pira'nha, flesh eating fish, genus Serrasalmo, found in rivers of South America; 12 to 24 in. long; triangular teeth; bold and savage; schools of these fish may attack and kill swimming animals as large as a horse.

Piraru'cu, or arapaima (ār-ā-pī'mā), largest known fresh water fish (Arapaima gigas) said to attain a length of 15 ft. and weight of 400 lbs; found in Brazil and Gulana; important food fish.

Pirates and piracy P-222

Algeria A-126

Algoria A-126
Astack repelled by fireworks F-60
Barbary States L-1216: Cervantes
captured by C-135; Decatur attacks D-23
Captain Kidd K-15-16

Caribbean Sea C-306, P-43 international law I-108-9 Malay pirate boats B-166 Northmen N-166-70

Pompey rids Mediterranean Sea of P-302 privateering distinguished P-222

Saxons S-34 Vandals V-272

'Pirates of Penzance, The', comic opera, words by W. S. Gilbert and music by Arthur Sullivan, first pro-duced in New York City 1879; scenes are laid on coast of Cornwall, England.

Pirene (pi-rē'nē), a spring said to have been struck out of the Acro-corinthus by the hoofs of Pegnsus; sacred to Muses.

Pirithoüs (pī-rith'ō-ŭs), king o Lapithae, friend of Theseus T-79

Pirna (pir'nd), town of Saxony, Germany, on Elbe River 11 ml. s.e. of Dresden; pop. \$1,000; Prussians defeated Saxons in Seven Years' War Oct. 17, 1756.

Pisa (pë'zü), city in n. Italy; pop. 68,000; famous for leaning tower: P-222-3, I-164, map I-156 baptistery P-222, picture I-168: pulpit S-56, picture E-335 cathedral: pulpit S-57, picture E-331

history P-222-3 leaning tower P-222, G-143, picture

Pisa, Council of (1409), Church council which deposed rival popes cil which deposed rival popes Gregory XII and Benedict XIII; elected Alexander V.

Pisagua (pē-sä'gwä), Chile. in n.; pop. 1000: C-207c, map C-206 Pisano (pē-sā'nō), Andrea (Andrew of Pisa) (1270?-1348?), Italian

sculptor, pupil of Giovanni Pisano; made bronze doors on south side of Baptistery at Florence: S-56-7

bas-relief, picture I-173

Pisano, Giovanni (John of Pisa) (1250?-1330), Italian sculptor, one of greatest of Renalssance, founder of Italian Gothic style; son of Niccolo Pisano

pulpit by S-57, picture E-331

Plano, Niccolo (Nicholas of Pisa) (1206?-78), Italian sculptor and architect, "first great precursor of the Renaissance"

pulpit by S-56, picture E-335

Piscat'aqua River, forming part of boundary between Maine and New Hampshire; flows into Atlantic 3 mi. s.e. of Portsmouth: map M-38

Piscat'aquog River, small river in New Hampshire, tributary of Merrimack. Pisces (pis'ez), fishes, a class of vertebrates, Outline Z-229

Pisces, a constellation and sign of the Zodiac Z-218, charts S-275e, f. g

Pisgal (yis'jā), mountain in Palestine from which Moses saw the Promised Land; identified with with Nebo (Deuteronomy xxxiv, 1).

Pisidia (pi-sid'i-a), ancient district of s. Asia Minor; mountainous, with wild and warlike inhabitants who kept independence against all successive rulers of Asia Minor until reduced by Rome.

Pisistratus (pi-sis'trā-tūs), or Peisistratos (605?-527 B.C.), "tyrant" of Athens G-157-8

Aesop's fable of A-28

Pissaro (pē-sā-rō'), Camille (1831–1903), French landscape and figure painter, born St. Thomas (now Charlotte Amalie), Virgin Islands, Jewish parentage; became allied with the Impressionists and developed an individual style; especially concerned with painting of sunlight.

Pistachio (pis-tü'shī-ō) nut N-187, picture N-188

Pis'til, seed-developing structure in flowers F-120-1, pictures B-204, F-122, 125-7

Pis'tiliate flowers, flowers without stamens F-121

Pis'tol, in the 'Merry Wives of Windsor', a swaggering bully, companion of Falstaff.

Pistol, a small firearm F-52

early types, pictures F-49 Very pistol used in signaling S-143 X-ray test, picture X-201

Pistol lighter, for making fire, pictures M-87, F-47

Piston, Walter (horn 1894), composer and teacher, born Rockland, Me.; studied at Harvard and in Paris; teacher of music at Harvard; composed chamber music and orchestral works.

Pision, the disk or plunger inside a cylinder, in which it moves by pressure or by a direct force automobile A-397-8

cornet H-339 steam engine S-280, 282, 283 Pit, in board of trade B-160

Pita. See in Index Istle

Pit'cairn, John (1740-75), British army officer, commanding Gage's

troops in expedition to Lexington and Concord; killed at Bunker Hill: L-100

iteairn Island, in South Pacific Ocean (British) P-8, map P-10c Pitcairn

Pitch, black or dark brown substance, solid at ordinary temperatures, ob tained by distilling off more volatile portions of wood-tar, coal-tar, or certain oils; often called tar: T-12, C-289

Pitch, in golf, picture G-117 Pitch, of sound S-196, 197 equalization of pitch in piano P-213 notation for M-318, 319 voice V-331

Pitch'blende, a uranium ore, source of radium R-34, M-183

Pitcher, Molly (died 1823), heroine of Revolutionary War; said to have been made sergeant by Washington for taking place of her fallen hus-band and serving his cannon at battle of Monmouth. According to another story she won her nickname by carrying water to soldiers.

Pitcher, in baseball B-56a-b, diagram B-54, picture B-55

Pitcher plants P-223, picture P-243 Pitch Lake, Trinidad T-141, pictures A-336, 337

Pitch pine, evergreen pine (Pinus rigida) of pine family, native from New Brunswick to Georgia and Kentucky. Average height 60 ft.; rounded, irregular shaped crown. rounded, irregular snaped crown.
Leaves in threes, to 5 in long, dark
green; cones oval, to 4 in long.
Wood brittle, knotty, with many
resin ducts distinctly showing; used
for rough lumber, boxes, mine props,
fuel. Not to be confused with slash
pine which is often called pitch pine.

Pith, spongy core of many plant stems.

Pithecanthro'pus erectus, the erect ape-man A-225, M-46

Pitiscus, Bartholomaeus (1561-1613). mathematician D-27

Pitman, Sir Isaac (1813-97), English inventor of Pitman system of shorthand and advocate of simplified spelling S-134

Pitot (pô'tō) tube, in aviation, a tube with an open end facing the direction in which the airplane is moving. It indicates the air speed.

Pitt, William, the Elder. See in Index Chatham, Earl of

Pitt, William, the Younger (1759-1806), English statesman P-224

Pit'tacus (died 569 B.C.), statesman of Mytilene; hero of war against Athens; popularly elected ruler 589-579 B.C.

one of Seven Wise Men S-193 Pitt diamond, or Regent diamond D-63, picture D-63

Pitti (pēt'tē) Palace, in Italy I-170, table M-392 in Florence,

Pittsburg, Kan., coal-mining city 120 mi. s. of Kansas City; pop. 17,571; railroad shops, foundries, machine shops, pottery works; state teachers college: map K-4

Pittsburgh, Pa., 10th city of U. S.; pop. 671,669: P-224-6, map P-112 Carnegie Institute, Department of Fine Arts, table M-392 Carnegie plants C-86 educational institutions P-225-6

history P-226: railroad strikes (1877), picture H-253 industries P-225

Pittsburgh, University of, at Pittsburgh, Pa.; non-sectarian; chartered 1787 as academy, 1819 as university; present name 1908; arts

and science, engineering, education, law, medicine, business, pharmacy, dentistry; graduate school building P-225 picture C-301

Pittsburgh of the South, name applied to Birmingham, Ala. B-146

Pittsburg Landing, or Shiloh, battle of (1862) S-116, map C-253 Sherman at S-115

Pittsfield, Mass., residential city and summer resort in Berkshire Hills and lake region, 35 mi. n.w. of Springfield; pop. 49,684; electrical machinery, textiles, stationery, and papers used by government for currency and bonds: map M-82 early cattle show F-4

Pittston, Pa., city on Susquehanna River 8 mi. n.e. of Wilkes-Barre in anthracite coal region; pop. 17,828; paper, silk, knit goods, machine shop products; named for elder William Pitt.

Pituitary (pǐ-tū'ī-tĕr-ĭ) gl. G-99-100, B-221, picture B-220 Pit vipers, a subfamily of poisonous snakes V-302-3, S-171 copperhead C-361 moccasin M-212 rattlesnake R-52

Pi'us I (died 154? A.D.), pope P-226

Pius II (1405-64), pope P-226 records early use of coal C-283 Pius III (1439-1503), pope P-226 Plus IV (1499-1565), pope P-227 Pius V (1504-72), pope P-227 Cosimo de' Medici and M-107 Plus VI (1717-99), pope P-227 Pius VII (1740-1823), pope P-227 Pius VIII (1761-1830), pope P-227

Pius IX (1792-1878), pope P-227 loses temporal power I-158 Pius X (1835-1914), pope P-227 Pius XI (1857-1939), pope, elected in 1922 P-227

Pius XII (born 1876), pope, elected in 1939 P-227a, color plate P-227b Piute (pī-yut') Indians. See Paiute

Pixtes, mischievous sprites or fairies stories S-303f

Pizarro (pi-zăr'ō, Spanish pē-thār'ō) Francisco (1471?-1541), Spanish conqueror of Peru P-227a, 228 Charles V and, picture S-227 Ecuador E-155 flag F-100, color plate F-90 Incas I-27

Pizzetti (pēt-sčt'tē), Ildebrando (born 1880), Italian composer, b o r n Parma; director Milan Conserva-tory; in operas 'Debora e Jaele', 'Fra Gherardo', and 'Lo Straniero'; wrote his own libretto and followed theory that text should be confined to essentials of drama without a single word unsuited for musical expression.

Place de la Concorde (plás dử là kôn-kôrd'), Paris P-72 Place de l'Etoile (lā-twäl'), Paris,

picture P-73 Arc de Triomphe, picture P-71

Place de l'Opéra, Paris P-72, picture

Placen'tal mammals, the placentalia M-44

Pincantia Bay, on s. e. coast of Newfoundland; U. S. naval, air, and army base: map N-51

Placer mining M-186, 188 g o 1 d G-111-12, pictures A-102, A-371: with dredge, pictures D-103, G-113

Placket, of a dress, cutting S-90 Plague. See in Index Bubonic plague Plaice (plas), or flounder, a flatfish F-117, F-103-4, picture F-105

Plaid (plåd), a rectangular woolen garment cross-barred with different colors, worn by Scottish Highlanders, each clan having its own pattern; also any fabric having a pat-tern of bars or stripes crossing each other at right angles: color plate T-63a-b

Highland dress, picture S-44 Plainfield, N. J., city 22 mi. s.w. of New York City; pop. 37,469; metal novelties, printing presses, motor trucks, silks: map N-90

Plains, extensive stretches of level land P-198-200. See Coastal plain llanos S-208f, k, C-305, C-108, V-274-5, map S-208d North America N-151: U. S. U-183, map U-200

pampa A-278-9, S-208h, maps A-279,

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savannas A-36, map S-208d
steppes R-180, A-330, H-360, map A-332a tundras

ndras N-151-2, A-325, A-332*a, picture* R-179

Plains Indians, name given to group of tribes inhabiting great plains of U. S. I-54, picture I-54 buffalo dance, picture 1-66 bullboat B-166

sign language and "pictographs" I-62-3

teepee I-59, pictures I-54, 60 Plains of Abraham, battlefield near Quebec where Wolfe defeated Mont-calm (1759) W-129, M-246, Q-7

Plains rattlesnake R-52 (plăn'chēt), Planchet coin blank M-196

Planck (plängk), Max (born 1858), German physicist, born Kiel; greatest work and many publications in theoretical physics, especially ther-modynamics; his theory of radiawas the foundation of the quantum theory, associated with his name; won the Nobel prize in physics 1918; R-16

Planck's constant, in physics R-16 hydrogen spectrum explained by S-244

Plancon (plän-sôn'), Pol Henri (1854-1914), French dramatic singer; sang in Paris, London, and with Metropolitan Opera Co., New York; most famous bass of his time (Me-phisto in 'Faust').

Plane, in geometry, an absolutely flat surface which will entirely inclose a straight line drawn between any two of its points.

Plane, a tool T-111 safety in using S-2g Plane, focal, of lens L-97

found by P-181-2 focusing the camera human eye E-349

Plane, inclined, in mechanics M-103,

104, 105, piotures M-106 used in building pyramids, picture used P-371

Plane geometry, defined G-46. See also in Index Geometry

Plane polarization, of light L-130 Plane printing, or surface printing E-293-4, 298, L-164

Planer, a machine tool T-111, 112 Plane surveying S-331-2

Plane-table, a flat board provided with sights, generally attached to a tripod; used in topographic surveying locating forest fires: picture F-156

Planeta'rium, an electrical and mechanical apparatus for projecting on a domelike ceiling images of astronomical bodies in their natural motions; first one built at Zeiss optical factory in Jena, Germany; later several built in the U. S.—Adler, in Chicago; Fels, in Philadelphia; Griffith, in Los Angeles; Hayden, in New York City; Buhl, in Pitts-burgh; and smaller ones in Spring-

field, Mass., and San Jose, Calif.
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spectrum analysis reveals characteristics A-344, S-242-3 Uranus P-230, 233, A-348-50, dia-grams P-230, 231, table P-231 Venus P-230-1, diagrams P-230, 231, picture P-232, table P-231

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Planquette (plān-kêt'), Jean Robert (1848-1903), French composer of light and graceful operas ("The Chimes of Normandy").

Plant, Henry B. (1819-99), American railroad man F-114

Plant, Morton F. (1852–1918), American railroad man, son of Henry Plant, born New Haven, Conn.; active in the Plant system of railroads and the Peninsular & Occidental Steamship Co.; endowed Connecticut College for Women.

Plant. See in Index Plants

Plantagenet (plān-tāģ'ē-nēt), House of, also called House of Anjou, line of English kings (1154-1899), list T0-270

Henry II founds H-275

Plantain (plăn'tin), several varieties of banana B-36

Plantain, or ribwort, herbs, usually stemless, comprising the genus Plantago of the family Planta-ginaceae, having a rosette of broadribbed leaves from which arises an elongated spike of small greenishwhite flowers

seed stalks, picture N-38

Plantain-lily. See in Index Hosta Plantations Brazil B-226a Central America C-1330 Honduras, picture C-133b pre-war South, in U.S. A-163-5, U-244 Plant breeding P-245d-e, B-203. See also in Index Plant improvement Plant communities E-145g, i, 146 Plant diseases P-245c-d, S-262, B-114. See also in Index Insect pests blight B-156 carried by insects I-90 ergot of rye R-202 immunity P-245d mildews and molds M-169-70 parasites P-70 quarantine of imports I-110d: Federal Quarantine Act I-90 rusts and smuts R-199-201 trees killed by F-156 wilt of cotton C-380 Plant fibers T-69. See also Fibers Plan'tigrade animals, those whose heels touch the ground F-146 bear B-67, pioture B-67 digitigrades developed from, picture H-340 raccoon R-9, pietures R-9a Plant improvement P-245d-f, A-51, 53, B-203, Outline A-60 Burbank's work B-276-7 flowers canna C-72-3 carnation C-85 chrysanthemum C-231 cosmos C-373 dahlia D-1 fuchsia F-215 magnolia M-35-6 pansy P-54 rose R-158, picture P-241 Shasta daisy D-5 tulip T-149 fruits F-211 apple A-231-2 grape G-135 limequat L-138 loganberry L-180 mango M-53 orange O-238 pear hybrids P-95 plum P-260 raspberry R-51 strawberry S-306 grafting F-211, pictures F-213 grains P-244, A-53: corn C-368-9; rust and smut proof R-200-1, O-191; wheat W-82 growth promoted P-2456-f hybridization P-244, B-276 Mendel's laws of heredity H-284 patents for new varieties P-88 rubber R-164 P-245d-e, bees selection B-276. C-367, plotures C-366a sugar beet B-79 vegetables asparagus A-336 cabbage group C-1-3 potato B-276, A-53, P-325

antin (pldn-tdn'), Christophe (1514-89), French printer; head of a famous printing house in Antwerp, which was converted into a museum in 1877; became in 1571 court printer to Philip II of Spain; noted for a polyglot Bible: T-174

Plant Industry, Solls and Agricultural Engineering, Bureau of, U. S. U-228

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grafting F-211, pictures F-213
"Plant wizard," nickname for Luther
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Plaskon, a synthetic plastic P-246
Plasma (plāz'mā), a green variety of
quartz-chalcedony with white or
yellow spots, engraved as a gem by the ancients.

Plasma, of blood B-157, 157a-b transfusion B-158, picture B-157b Plasmodium, a mass of naked proto-

plasm in slime molds S-163 malaria parasites M-267-8

materia parasites m.-207-8 Plussey (plä'si), town of British India, 75 ml. n. of Calcutta; battle (June 23, 1757): C-272, map I-30 Plustacele, a synthetic plastic P-246

Plaster, a mixture of quicklime, sand, hair or fiber, and water, forming a paste which hardens when dry; used for walls, ceilings; mixture varies for different purposes: L-138 Plaster, lime L-138

Plaster of paris, a white powder madof ground gypsum, so called be cause gypsum was early used near Paris in making plaster and ce-ment; used for molds, also for bandages and casts for wounds, de-

formities, and fractures mineral source M-183 pottery molds P-328 use in sculpture S-65 Plasticity, in physics P-190 Plasticizer P-245j lacquers L-52

Plastics, materials that can be readily molded, especially synthetic plastics P-245i-46 airplane manufacture A-82

bakelite P-245i-j, C-289
casein products P-245i, j-k, M-173
celluloid C-122-3, P-245i, j
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corn products, chart C-366b plywood, use in P-264 pyroxylin P-373, P-2451, 246 rubber substitutes R-170 soy bean products S-224 synthetic resins P-245i-46, R-78

Plastic surgery, a branch of surgery comprising the correction of mal-formations, particularly of the face, the removal of scars, and the repair of mutilations.

Plas'tron, part of turtle shell T-168 Plataea (plā-tē'ā), ancient city of Boeotia, Greece battle of (479 B.C.) P-136: Aristides at A-283

helps Athenians at Marathon P-135 Plata (plä'tä) River, or Rio de la Plata, great estuary on e. side of S. America formed by junction of Parana and Uruguay rivers P-246, A-280, maps U-262, S-208c, A-279 at Buenos Aires B-259-60, picture H-217

Plate, of vacuum tube R-21, diagram R-22

Plate armor A-304, picture A-305 Plateau (pla-tō'), Joseph A. F. (1801-83), Belgian physicist bubbles, study of S-178

Plateau, an expanse of elevated, com-paratively level land P-198-200 Laurentian L-72

Plateau, in learning L-80-1 Plated silverware S-152 Plate glass G-102, picture G-101 automobile consumption A-392 Platelet (plat'let), blood B-157, 157a

Plat'en, in a printing press, surface that presses paper against type to make an impression P-347-8

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metals I-134 wire W-119, P-246

Plat'inum-irid'ium, an alloy extremely resistant to wear A-133, P-246

Plato (plā'tō) (427-347 B.C.), Greek philosopher, pupil of Socrates P-247 Aristotle and A-283, 284 Atlantis, description of A-360 quoted on Socrates S-189 social beliefs S-182, 184

Platoon', in U. S. Army A-307b Plateon system, in schools S-40 Gary G-17

Platt, Charles Adams (1861-1933) American architect, born New York City; although a skilful painter and etcher, his most important works were in architecture; greatly influ-enced by the Italian form.

Platt, Orville Hitchcock (1827-1905), American statesman, born Wash-ington, Conn.; served in U. S. Sen-1879 until death; introduced Platt Amendment.

Platt, Thomas Collier (1833-1910), American politician, the "easy boss" (Republican) of New York State; said to have forced Roosevelt's nomination 1900 for vice-president. Platt Amendment, defining U. S. rela-

tions with Cuba C-412, M-16 Platten See (plat'én zā), or Lake
Balaton (ba'la-tōn), largest lake in
Hungary, 60 ml. s.w. of Budapest;
50 ml. long, 6-10 ml. wide; rich with
fish; popular resort: map A-381

Platte Purchase (1837) M-210 Platte River, largest tributary of Missouri, formed by union of north and south forks of the Platte in s.w. Nebraska; flows e. in great curves and enters Missouri River on Iowa border; length of main stream 200 mi.: map N-57

early name N-60 Oregon Trail follows F-16 Platt National Park, Okla. N-22d

Plattsburg, N. Y., garrison town and summer resort on w. shore of Lake Champlain, 74 mi. s.e. of Montreal in farming and dairying section; pop. 16,351; matches, paper prod-ucts; state teachers college, Cham-plain Summer School; important plain Summer School; important naval battles of Revolutionary War and of War of 1812 fought near by; S. Army training camp: map N-114

Platyco'don. See in Index Balloonflower

Platyhelmin'thes, a phylum of animals comprising the flatworms: Z-227

Plat'ypus, or duck-bill, an egg-laying mammal D-118-19, M-44, Z-222 egg, picture E-193 foot, picture F-147

Platyrrhine (plăt'i-rin), division of monkeys M-231

Platystemon (plūt-i-stē'mōn), or cream-cups, an annual plant (P. californicus) of the poppy family, native to California. Grows to one ft.; leaves oblong; flowers one in. across, cream-yellow, with stamens forming a feathery center for each blossom.

Plauen (plou'ĕn), town of Saxony, Germany, 21 mi. s.w. of Zwickau; pop. 111,000; chief center in Ger many for manufacture of white cot-

ton goods, including machine lace.
Plautus (pla'the), Titus Maccius
(2547-184 B.C.), Roman comic
dramatist ('Amphitus'; 'The Captives'; 'The Pot of Gold'): L-68, D-93

Play and Games P-247-58. See also in Index Games; Sports; Toys babies and young children P-256-7,

B-3 blind man's buff, picture K-18 child development, part in C-202, pio-tures C-200, 201, 202 foreign lands P-250: how to play

P-250-5

"jan-kem-po" (Japanese) J-193 kindergartens and nursery schools K-18, 20

older children P-250-5 "snapdragon" C-229

'Playboy of the Western World, The', comedy by John M. Synge based on Irish peasant life; Christy Mahon regarded as a hero when he confesses in glowing color that he has murdered his tyrannical father with a spade: when his father appears only slightly hurt, Christy is turned upon as a despicable person.

Player-piano P-212, diagram P-213 Playgrounds, public

accident prevention S-2g Cleveland P-247, pictures P-248-55 growth of L-93c Oklahoma City O-221 story-telling S-302

Playing cards C-83-4 "Playing 'possum," origin of expression 0-235

Play materials P-258. See also in Index Toys

homemade camp equipment C-45 Plays, dramatic D-91-9. See also in Index Drama

production: bibliography H-313m-n Plaza, Nicanor (1844-1918), Chilean sculptor; for many years professor of sculpture in School of Fine Arts in School of Fine Arts in Santiago; principal work Quimera': L-67k

Plaza (from the Spanish), a public

Plaza (from the Spanish), a public square
Latin America L-67c
Lima, Peru, picture L-67p
Madrid, Spain M-24, picture M-22
Mexico City, picture M-144
Pleasantville, N. J., residential city
7 mi. n.w. of Atlantic City; pop.
11083. cummer resort

11,050; summer resort.

Plebe'ians. See in Index Plebs

Plebiscite (pleb'i-sit), a French word meaning a vote of all the electors on some specific question; used several times in France for political issues; after 1st World War plebiscites were taken to settle various boundary disputes

East Prussia and Silesia P-276-7 Napoleon III N-11 Schleswig D-50, 53, map D-53 Tacna-Arica P-140-1

Plebs (plebz), or plebeians (plebe'anz), the lower order of citizens of ancient Rome R-130-2

struggle for self-government D-46 Plecop'tera, an order of four-winged insects consisting of the stone flies. Pledge. See in Index Oath, or pledge

Plehve, Viatscheslaf Konstantinovitch (1864-1904), Russian official, head of secret police and later minister of interior; oppressive measures brought on his assassination by revolutionists.

Pleiades (plē'yā-dēz), in Greek mythology daughters of Atlas P-259 Pleiades, group of stars P-259, charts S-275, 275f, h nebulae N-60

Pleistocene (plis'tō-sēn) epoc geology G-42, picture G-41 remains of man M-45-6, A-225 epoch. in

Plenipoten'tiary ministers D-70, 71 lesiosaur (ple'si-ō-sqr), extinct aquatic reptile of Mesozoic Age; long neck and paddle feet. Plesiosaur extinct

Pleura, the serous membrane covers the lungs, lines the walls of the thorax, and is reflected upon the diaphragm: L-219, diagram L-219

Pleu'risy, an inflammation of the pleura P-206

Pleurisy root, or butterfly weed M-174 Pleura (plev'nd), town in n. Bul-garia; pop. 32,000; celebrated for gallant resistance of Turks during siege in Russo-Turkish (1877): map B-18 War

Plexiglass, a synthetic plastic P-246 Plexus, a network of veins or nerves

Pliers, a tool T-110

Plimsoll, Samuel (1824-98), English politician and reformer, born Bristol; secured legislation which has protected the English merchantseaman; author of 'Our Seamen', 'Cattle Ships'.

Plimsoll mark S-123, picture S-129
Pliny (plin'i) the Elder (Gaius
Plinius Secundus) (23-79 A.D.),
Roman author and official; great
reader and student; in his 'Natural History collected a vast array of interesting facts; killed when he left a ship to observe the great eruption of Mt. Vesuvius: L-69

electrical experiments E-231 glass, story of discovery G-101 soap first referred to S-175 zoölogy Z-227

Pliny the Younger (Gaius Plinius Caecilius Secundus) (61?-113? A.D.), nephew of the elder Pliny, who adopted him; long career as important public official; his col-lected Letters' give a vivid picture of the life of a Roman gentleman Letters' L-69 Pliocene (pli'ō-sēn) period, in geologic time G-40, 42, picture G-41 Pli'ofilm R-168

Ploce'idae, a bird family B-132

Ploesti (plô-yĕsht'), Rumania, town 40 mi. n. of Bucharest; pop. 77,-000; petroleum center: map E-3266 air raids W-179c

Plotinus (plō-ti'nŭs) (204?-270)philosopher of Neo-Platonic School, native of Egypt; studied at Alexandria; taught at Rome; foremost philosopher of mysticism; wrote Enneads'.

"Ploughboy Poet" nickname for Rob-ert Burns B-280

Plovdly (plôv'dif), also Philippopolis, 2d city of Bulgaria, 80 mi. s.e. of Sofia; pop.100,000; ancient Thracian city; huge trade in silk, cotton, attar, grains, and hides: map B-18

Plover (pluv'er), a shore-bird P-259. See also in Index Killdeer foot, picture B-129

migrations of golden plover M-163-4, P-259, picture-map M-164 nests on ground B-126

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Plug-and-feather, method of quarrying Q-2

Plum, a tree of the rose family P-260 Burbank develops varieties B-276 prune industry P-358

Plumage F-20. See also Feathers

Plumb, a tool T-112

Plumbaginaceae (plŭm-băġ-i-nā'sē-ē). See in Index Leadwort family Plumbago (plum-bā'gō). See in Index

Graphite

Plumbago, or leadwort, a genus of chiefly perennial plants of the leadchieff perennal plants of the lead-wort family, native to warm parts of Africa, Asia, and Europe. Mostly climbing or trailing plants with oval leaves; flowers in loose clus-ters, blue, red, or white, saucer-shaped; roots formerly used in medicine.

Plumbing P-260. See also in Index Sewerage; Waterworks earthenware drain pipes B-239, pic-ture C-260

freezing of water pipes W-43 lead pipes L-76

Plum'bum, Latin name for lead. See in Index Lead

Plum'cot, a Burbank fruit B-276

Plum curculio (kûr-kū'lī-ō), a weevil (Conotrachelus nenuphar), injurious to plum, peach, cherry, and apple trees.

Plumed Knight, nickname for James G. Blaine B-155

Plumed Serpent, symbol of the Central American god, Quetzalcoatl M-142b, pioture M-142c

Plume moth, small, delicate, long-legged moth, whose hind wings are split to form "plumes" B-286

Plume poppy (Bocconia), a genus of tall plants of the poppy family with heart-shaped lobed leaves and large panicles of small pink, bronze, or greenish flowers; a stately plant valued in the garden for its beauty how to plant G-10

Plummer, Mary Wright (1856-1916), London was the s. branch. See also in Index London Company Ind.; became librarian (1894) and Plymouth Rock P-262, picture P-261

teacher (1904) at Pratt Institute; after 1911, head of library school New York Public Library: L-106f Plumule (plu'mūl), first bud of an embryo, pictures B-66

Plunkett, Sir Horace Curzon (1854-1932), Irish publicist, perhaps the foremost advocate of compromise in the settlement of the Irish question; founded Irish Agricultural Organization 1894, and 1899-1907 was vice-president of Irish Agricultural Department, through which he constantly labored to improve condition of Irish farmer.

Plu'ral, in grammar nouns N-179: spelling of S-247 pronouns P-352 verbs V-281

Pluralists, in philosophy P-173 Plural'ity, in elections E-214 Plush, a fabric T-69

Plutarch (plu'tärk) (about 46-120 A.D.), Greek biographer P-260 Lycurgus, story of L-222 Shakespeare borrows plots S-100

Plu'to, or Hades, in Greek and Roman mythology, god of underworld P-260. See also in Index Hades

Pluto, a planet P-229, 233, 230, dia-grams P-230, 231, A-343, table P-231 discovery A-350, P-233

eccentricity P-233

Plutus (plu'tus), in Greek mythology, god of riches; said to have been blinded by Zeus so that he would distribute wealth to worthy and unworthy alike.

Plymouth (plim'uth), England, important port in s.w.; pop. 210,000:

P-261, map E-270a

Plymouth, Mass., manufacturing town on e. coast, first New England set-tlement; pop. 18,100: P-261-3, may M-82. See also in Index Plymouth Colony

Plymouth, N.H., town 51 mi. n.w. of Concord; pop. 2533; gloves, wood products; state teachers college; here Webster made first public appearance as a lawyer: map N-86

Plymouth, Pa., coal-mining borough on Susquehanna River, 4 mi. w. of Wilkes-Barre; pop. 15,507; mining machinery, hosiery.

Plymouth Brethren, a Christian de-nomination that originated in British Isles about 1825-30, and became prominent in Plymouth. They are opposed to church government and an official ministry, insisting on the right of all believers to preach; membership in U. S. about 26,000. Plymouth Colony P-261-2 financing A-152, 153

Massachusetts Bay annexes M-86 Mayflower arrives M-92 Miles Standish S-270 New England Confederation A-156 origin and founding A-151 Roger Williams in W-104 Thanksgiving T-74

Plymouth Company, also known as Virginia Company of Plymouth, organized 1606 by King James I of England to establish colonies in North America between 38° and 45° north latitude; settled colony at north latitude; settled colony at mouth of Kennebec River in 1607 which was abandoned following year; 1620 reorganized as Plymouth Council for New England. Plymouth Company was the n. branch of a joint land stock company of which the Virginia Company of London was the s. branch. See also in Index London Company.

Plymouth rock, a breed of poultry P-338, picture P-337 Plywood P-264

airplane manufacture A-82 Plzen (pŭl'zen) (German Pilsen), city of Germany, in Bohemia 53 mi. s.w. of Prague; pop. 125,000; has historic 16th-century town hall; had first printing press in Bohemia, fine buildings, famous breweries; steel machinery, guns: maps G-66, C-422 P. M. (Latin post meridiem) T-95

Preumatic (nū-māt'ik) appliances P-264-5 air brake B-224-5 caissons B-264 Diesel engine starter G-20

diving apparatus D-72-3 dredges D-105

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riveter (hammer) P-265 tire R-166-7, pictures R-166, 167, 168.

torpedo engine T-114 tubes P-264-5, pictures P-264, H-215: mail P-265, P-317 tunneling shield T-153-4, P-265 vacuum cleaner V-268

Pneumaties, science of forces and motions in gases P-193, G-18, Outline P-196. See also in Index Gas, in chemistry and physics

Pneumogas'tric nerve. See in Index Vagus

Pneumonia (nū-mō'nī-a), a lung disease

bacteria causes G-78 treatment A-224

Pnom-Penh (pnōm-pēn'), commercial center and cap. of Cambodia. French Indo-China, in s. on Mekong River; pop. 105,000: maps A-332c. I-73b

Pnyx (niks), a hill in Athens A-355 Po, chief river of n. Italy P-266, map I-156

fertile valley E-318

Pocahontas (pō-kā-hōn'tās) (1595?-1617), Indian "princess," traditional ancestress of many Virginia families by her marriage to John Rolfe, a Jamestown settler

Capt. John Smith and S-165 Pocahontas coal C-288, V-306

Pocatel'io, Idaho, 2d largest city in state, on Portneuf River in s.e.; pop. 18,183; extensive railroad and live stock interests; wholesale trade; creamery products, cement, flour; University of Idaho, Southern Branch: map I-8

Pocket, of a dress, binding, diagram S-89

Pocket battleship N-56f Pocket billiards, or pool B-109 Pocket borough P-78 Old Sarum C-156 Pocket compass C-325 Pocket gopher G-120-1 Pocket veto V-292

Pocomoke Swamp, in Delaware D-40a Po'cono, Mount, Pa., long ridge in Monroe and Carbon counties, about 20 mi. s.e. of Scranton; 2215 ft. high; summer resorts.

Pod-corn C-369

Podiatry (pō-di'à-tri), the art of treating disorders of the foot; same as chiropody.

Pod'sol, a type of soil S-191b, d, map S-191c

oe (pô), Edgar Allan (1809-49), American poet, critic, and short-story writer P-286, A-177, picture A-177 Poe (pō).

grave and monument in Baltimore

B-34, M-79 Maelstrom described by W-85 memorial in Richmond, Va. R-107

Poes'tenkill, short crooked stream entering Hudson River at Troy, N. Y.; furnishes water power.

Poetic Edda S-36 Poet laureate P-266

Poet of Democracy (Whitman) W-95 Poetry P-267-71. See also in Index American literature; Canadian literature; English literatuothers; Figures of speech English literature,

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C-230 "father" of American B-255; of Eng-

lish C-158

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kinds P-271. See also in Index Ballads; Epic poetry; Lyric poetry limericks L-138 Muses of M-305

rhyme P-268-9, 270 rhythm P-267-9, W-187 theories of P-268: Dryden's D-115; Whitman's W-95; Wordsworth's W-146

writing of P-268, W-189

Poet's Corner, W-73, C-160 Westminster Abbey

Pogany (pō-giān'ē), Willy (William Andrew) (born 1882), American book illustrator and mural painter, born Hungary; work is romantic and imaginative, with touch of the oriental; known also for stage and costume designs.

Poggio Bracciolini (pôd'ýō brät-ohō-lē'nē), Gian Francesco (1380-1459), Italian scholar of Renaissance; dis covered and restored many ancient Latin literary manuscripts; wrote moral essays, satires, humorous and sometimes obscene stories, and a history of Florence, Italy.

Pogrom (pō-grom'), a massacre of unarmed civilians, especially of Jews in pre-war Russia; in the Russian pogroms of 1903 and 1905 thousands were killed or tortured, and a great wave of emigration resulted.

Pogy, or menhaden, an oily fish of the herring family H-287, F-82 young sold as sardines S-28

Poi $(p\bar{o}'\bar{e})$, a food used in the Pacific Islands H-241, picture P-6

Poletesme (pwä-têm'), kingdom described in Cabell's novels A-181

Pollu (pwä-lii'), a term meaning "hairy" or "bearded," applied during World War (1914-18) first to a French soldier who had served in trenches and become bearded, later to any French soldier.

Poincaré (pwăń-kà-ra'), (Jules) Hen-(1854-1912), French mathematician and physicist.

Poincaré, Raymond (1860-1934), French statesman P-272 German policy F-182

postwar financial crisis F-182

Poinciana (poin-si-ā'nā), a genus of tropical trees or shrubs of the pea family with showy orange-yellow or bright scarlet blossoms; grown for hedges.

Poinsettia, a slender shrub (Euphorbla pulcherrima) 2 to 10 ft. or more in height bearing small yellow ter-minal flowers surrounded by flaring scarlet bracts sometimes 9 in. long; native to Central America and Mexico; named for Joel Roberts Polnsett (1779–1851), who first brought it to the U.S. from Mexico; a favorite hothouse plant, especially at Christmas time

Point, in herding cattle C-110

Point, in type measurement T-172 Point Barrow, Alaska, the northern-most cape of North America; whaling station; school for natives; average population of settlements about 500, almost entirely Eskimo: map A-105

Point d' Alengon (pwan da-lan-sôn') lace L-48

Point de Burano (bo-ra'no) lace, pioture L-48

Point de Galle (pwăn dŭ gal), Ceylon. See in Index Galle

Pointe-à-Pitre (pwăn-ta-pē'tru), Guadeloupe, chief seaport; pop. 45,000; exports cocoa, sugar, vanilla.

Pointer, a hunting dog D-80, 83, pictures D-80, 84

Point Hope, Alaska, promontory on n. coast, map A-105

Pointillism (pwăn'ti-liz'm) applied to an impressionistic painting process in which pure colors are applied to canvas in dots and are blended in the eye of the observer; chief exponents Seurat and Signac, French artists,

Point Lo'ma, Calif., promonto entrance to San Diego Bay S promontory at Cabrillo National Monument N-20

Point Pelee National Park, a Canadian park in s.w. Ontario N-23, G-150

Point Pleasant, W. Va., town on Ohio River at mouth of Kanawha; pop. 3538; here Virginians defeated Indians Oct. 10, 1774; treaty followed by which Indians gave up extensive tract s. of Ohio River: map W-76 battle V-308

Points of order, in parliamentary law P-80

Point system of type sizes T-172 Poise, in personality E-310-11

Poison dogwood, poison sumac, or swamp sumac P-272, S-325, picture P-274

Polson gas P-275. See also in Index Gas, in chemistry; Gas, for heating and lighting: Gas warfare insects that eject I-85, pioture B-84

Poison hemlock, a poisonous plant, with spotted stem and small white flowers H-272, S-189

Poison ivy P-272

poisoning: prevention P-272; treatment F-66 Virginia creeper distinguished P-272, picture I-176

Poison oak P-272 poisoning, treatment F-66

Poisonous animals ants eject formic acid A-211 black widow spider S-257 centipedes C-131 duckbill D-118-19 fish F-72: sting ray, picture F-68 Gila monster L-169, 171 hydra H-366, picture H-365 scorpions S-43 sea-anemone S-66

akes S-170-2, V-302-3; cobra C-290-1; copperhead C-361; mocsnakes S-170-2, casin M-212; rattlesnake R-52 tarantula T-12

wasps W-34

Poisonous plants P-272-4 European bittersweet B-152 fruit pit kernels C-419 hemlock H-272, P-274, S-189 ivy P-272, I-176, picture I-176 laurel L-72 locoweed W-64-5 mandrake M-53 milkweed M-173

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nightshade N-145, P-275, picture P-278

oak, poison P-272 oleander O-221

poisoning from, first aid F-66, P-275 rhododendron R-100 strychnos tree (nux-vomica) S-308, picture P-275

sumac S-325, P-272, picture P-274 upas tree T-136

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antimony salts A-222 arsenic compounds A-310

belladonna P-275. N-145, picture P-273

benzene B-97 carbolic acid C-81-2 carbon monoxide C-82 chlorine C-223 chromates C-231

cocaine N-12, P-275 copper compounds used as plant spray S-262-3 corrosive sublimate, or bichloride of

mercury M-120

cyanides and prussic acid C-418-19, P-275 first aid F-64

insect pests, for G-11 lead compounds L-76 narcotics N-12: treatment P-275 opium and derivatives O-234, N-12 oxalic acid, antidote L-138 phosphorus P-177 protection against S-2f snake venom S-172 strychnine S-308, P-275

Poison sumac, swamp sumac, poison dogwood P-272, S-325, pto-ture P-274

Poisson (pwä-sôn'), Adolphe (1849-French-Canadian 1922). poet ('Sous les pins'; 'Chants de soir').

Poisson, Siméon Denis (1781-1840), French mathematician and physicist; did special work in electrostatics and magnetism; explained vibrations of membranes; wrote scientific memoirs ("Traite 4") scientific memoirs Mecanique'). ('Traite

Poitiers (pwät-yā'), France, town 60 mi. s.w. of Tours; pop. 44,000; old churches, Roman remains; Charles Martel defeated Moors near by (732 A.D.)

battle of (1356) H-358

Poitou (nwä-tq'), old province of w. France; cap. Poitiers; governed by counts in Middle Ages; formed part of territory of Aquitaine; held by England 1152-1204 and again for short time during Hundred Years' War: map F-179

r.

Henry II acquires H-275

Pokeweed, pokeberry, or pigeon berry, a tall perennial plant (Phytolacca americana) of the pokeweed family with stout stem 6 to 10 feet high; purple-tinged, large alternate veiny leaves; greenish-white flowers; bears dark purplish berries con-taining a dark red juice; young shoots are edible; but roots are poisonous.

Pokeweed family, or Phytolaccaceae (fi-tō-lā-kā'sō-ē), a family of plants, shrubs, and trees, native chiefly to the tropics, including the pokeberry, agdestis, weed, and rouge-plant. guinea-hen

Pola (pō'lä), Italy, fortified town with one of finest harbors in Europe, on peninsula of Istria on Adriatic Sea; pop. 54,000; interesting Roman remains; before 1st World War chief naval station of Austria-Hungary: man A-381

Polaceo (pō-läk'kō), Giorgio (born Italian-American musical 1875). conductor, born Venice; with Metro-politan Opera, New York; Chicago Civic Opera, 1921-30.

Civic Opera, 1921-30.

Poland, former republic of cent. Burope, partitioned by Germany and Russia 1938; 150,000 sq. mi.; pop. 32,120,000: P-276-9, mays P-278, E-326d-e, f, Outline R-195 alphabet, special letters in, table

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Danzig Corridor D-14 war with Bolshevists W-175; boun-dary settlement P-277; Ukraine U-177

Paderewski P-11

Paderewski P-11
Teschen acquired C-421, map C-422
French alliance W-177-8
2d World War: alliance with England E-277; German and Russian invasion P-279, W-178d; fourth partition (1939) P-279, W-178d-e
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Slavic race S-162 Polish Corridor. See in Index Po-lish Corridor

products P-277, W-11; salt S-15 song, national N-26 Vistula River V-309

Poland China hog H-316

Polando, John L., aviator; made New York-to-Istanbul flight: A-73, table A-74 picture

Polar bear B-69, pictures Z-219, Z-225 altitude range, picture Z-228

Polar compounds C-174

Polar exploration P-279-86: Antarctic A-214, 216-17, maps A-214, 215, A-190; Arctic, maps A-277, A-190

Amundsen A-189-91, P-283-4 Andrée P-282, picture P-286

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Stefansson P-285-6 Wilkins W-97-8, P-286

Polar front theory, or Bjerknes theory, In meteorology W-61-2

Polar ice cap, on Mars P-231, picture P-232

Pola'ris. See in Index North Star Polar'iscope, an instrument for studying certain optical properties of substances, particularly sugars, by means of polarized light L-131

Polariza'tion, electric cell E-214-15 Polarization of light L-130-1, R-16 double refraction L-130-1, picture L-131

tartrates distinguished by T-14 Polaroid, a manufactured substance that polarizes light L-131

Polar regions, defined L-71, maps A-190. See also in Index Antarctic Continent; Arctic regions; Polar exploration

Polar Star, diamond, picture D-63 Polar zones, or frigid zones, of earth C-270a, b, 271, E-133, L-71, dia-gram E-133

gram E-133
Polásek (pö-lä'shēk), Albin
1879), American sculptor,
Bohemia; noted for vigportraits, whimsical groups, Albin (born vigorous and strong monumental works: S-64

Polder (pol'der), Dutch name for drained lowlands N-69, pictures E-319, I-150

Pole, Reginald ole, Reginald (1500–58), English Roman Catholic cardinal and archbishop of Canterbury, of whom his friend, Sir Thomas More, said that he was as learned as he was noble and as virtuous as he was learned; opposed divorce of Henry VIII and compelled to leave England; leader in Council of Trent; returned to England on accession of Mary.

Pole, of electric generator and motor E-217, 218

Pole, of magnet M-34, 35, E-227, pic-tures M-35, E-228 Pole, unit of measure W-66

Polecat S-157

olemoniaceae (pöl-ē-mō-nǐ-ā'sē-ē). See in Index Phlox family Polemoniaceae

Polenta (pō-lĕn'tä), an ancient and noble family of Italy; Francesca da Rimini was born a Polenta Ravenna ruled by R-53

Poles, magnetic, of earth E-132, M-34, picture C-327

aurora borealis related, picture A-366 explorers locate P-280, 283, A-190

north magnetic pole, map A-277
Pole Star, or Polaris. See in Index
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Turkish, picture T-163 world police force plans W-179j X-rays used by X-201

Zulu, East Africa, picture A-41 Police dog, or German shepherd D-83, picture D-83

Poling, Daniel Alfred (born 1884). American minister, born Portland, Ore.; pastor Marble Collegiate Re-

formed Church, New York City. 1923-30; president International Society of Christian Endeavor; edi tor Christian Herald

Polish Corridor, area along Vistuia River, formerly belonging to Ger-many, given to Poland by Treaty of Versailles, 1919, as outlet to sea; developed into prosperous commercial and industrial area with cial and industrial area with Gdynia the chief port; absorbed by Germany 1939: map G-66

Polishing, emery powder for E-260 Polish National Catholic Church of America, a religious denomination an outgrowth of Polish Roman

Catholic churches, formed in 1904; rejects doctrine of infallibility of pope in matters of faith and morals; believes in individual inter-pretation of scriptures; marriage of clergy allowed; membership in U. S. about 64,000.

Polish Succession, War of (1733-35) contest arising over the rival claims of the Elector Augustus of Saxony and Stanislaus Leszcynski to the throne of Poland. Stanislaus was backed by France, Spain, and Sar-dinia; Augustus by Russia and Austria; quarrel was pretext for settling old, outstanding issues between the great powers. The partisans of Augustus were ultimately successful.

Polish wheat, picture W-82 Politian (pō-lish'i-an), or Poliziano (pō-lēt-sē-ā'nō), Angelo Ambrogini (1454-94), Italian scholar and poet; under patronage of the Medici; one of most brilliant scholary of the light propertions of the light propertions and the light propertions and the light propertions and the light propertions are selected that the light propertions and the light propertions are selected that the light propertions are selected that the light propertions are selected that the light propertions are selected to the light propertion and the light propertion are selected to the light propertion and the light properties are selected to the light properties are selected to the light properties and the light properties are selected to the light properties and the light properties are selected to the light properties are selected to the light properties and the light properties are selected to the light pro

ars of Italian Renaissance.

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presidents elected, table P-422 primary P-345 socialist and communist L-45 spoils system C-248

vice-presidents elected, table V-392 Political science P-293-5, Outline P-294-5. See also in Index Government; Law; Political parties bibliography P-295

social sciences include S-184 Politics, Institute of, a conference held annually at Williams College, Williamstown, Mass., for the purpose of promoting the study of politics and international problems and relations; first session held 1921; founded through generosity of Ber-

nard M. Baruch. Poliziano (pō-lēt-sē-ä'nō), Angel Ambrogini. See in Index Politian Polje (pôľyč), Yugoslavia, also Kosovo, plain in s.w. near Prizren battle (1389) T-162

Polk, James Knox (1795-1849), 11th president of U. S. P-295-7 administration (1845-49) P-296-7 Buchanan secretary of state B-256 gold discovered in California C-34,

Mexican War P-296, M-131-2. See also in Index Mexican War Naval Academy established (1845) N-44-5

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W-126 Oregon question settled P-296, 0.047

Wilmot Proviso P-296, L-142 early career P-295-6 tomb in Nashville N-12a wife W-91

Polk, Leonidas (1806-64), American Confederate general, first Protes-tant Episcopal bishop of Louisiana;

fought at Shiloh, Stone River, Mur-freesboro, Chickamauga; killed while reconnoitering at Marietta, Ga. Kentucky in Civil War C-253

Polk, Sarah Childress (1803-91), wife of President Polk W-91

Polka, a sprightly, hopping, round dance in $\frac{2}{4}$ time; very popular in middle and late 19th century; originated in Bohemia; name applied also to music with the same rhythm.

Pollack, a fish of the cod family, which reaches a length of three feet and has a projecting lower jaw; common on both shores of the North Atlantic. The Alaskan pol-lack furnishes a large proportion of fur seals' food.

Pollainolo (põl-lä-19-5'lō), Antonio (1429?-98), Florentine painter, sculptor, engraver, goldsmith; master of perspective and anatomy, also of movement ('Hercules and Nessus', painting; 'Battling Nudes', engraving; 'Hercules and Antaeus', statuette).

Polled Angus cattle C-105

Pollen and pollination F-120-1, P-297, pictures F-123-6, N-29a agents F-120: bees B-76-7, 78, 74, C-281; humming-bird H-356, F-120; moths Y-211, F-120; wind P-297

clover C-281 cross pollination P-245d-e date palm D-18 fig F-31, picture F-32 milkweed M-173 water-plants W-48
yucca Y-211

Pollio, Gaius Asinius (76 B.C.-5 A.D.), Roman writer and orator; to him Virgil dedicated his Fourth Eclogue: L-103

Pol'liwogs. See in Index Tadpoles Pollock, Channing (born 1880), Amer-lean dramatist, born Washington, D. C. ("The Fool'; "The Enemy"). Pollock, Thomas, North Carolina leader N-159

Pollock vs. Farmers Loan and Trust Co., Supreme Court decision U-211 Poll tax T-17

Wat Tyler's Rebellion T-171

Pollux (pol'uks), in mythology C-95. See also in Index Castor and Pollux Pollyanna, young girl character in series of novels written by Eleanor H. Porter; with unrestrained opti-mism she sees good in everything.

"Polly Perkin," game P-257 Po'le, Maffee, uncle of Marco Polo P-298 Polo, Marco (1254?-1324), Venetian traveler P-298 Hangchow, China, visited H-210

Polo, N P-298 Nicolo, father of Marco Polo

Polo, a game played on horseback P-297

books about H-313e

Polonaise (pō-lō-nāz'), a slow, stately dance usually in ¾ time; originated in Poland, 1573; Chopin wrote best polonaise music.

Polo'nium. а radioactive element found in pitchblende; resembles bismuth in chemical properties; discovered by Pierre and Marie Curie in 1898 and named in honor of Poland: R-33, table C-168

Polonius (pō-lō'ni-ŭs), in Shake-speare's 'Hamlet', vain, garrulous old chamberlain, father of Ophelia: H-208

Polo pony H-344

Poltava (pōl-tti'vā), Russia, also Pultova or Pultowa, in Ukraine 200 mi. s.e. of Kief; pop. 130,000; trade in cattle, grain: map E-326e battle of C-154: Mazeppa aids

Charles XII C-374

Poltoratsk. See in Index Ashkhabad Polyan'dry, form of marriage F-8-9 Polyan'tha rose, picture R-157

Polyan'thus (Primula polyantha), a low stemless perennial garden plant of the primrose family with white, red, or yellow flowers in clusters how to plant G-11

Polyarnoye (pôl-ydr'nō-yĕ), formerly Alexandrovsk, Russian naval base 20 mi. n. of Murmansk, on Arctic

in first World War R-188

Polybius (pō-llb'i-ūs) (198?-117? B.C.), Greek historian; taken as prisoner to Rome after conquest of Macedonia, 168 B.C.; and accom-panied Scipio Africanus the Younger on military expeditions; wrote valuable history of the growth of Roman power.

(pŏl'i-kärp) (697-155? Polycarn A.D.), Christian martyr, bishop of Smyrna; called on to revile Christ, replied, "Eighty and six years have I served Him and He hath done me no wrong. How can I revile my Lord and Savior?"; was link be-tween Apostles and the early Cath-

olic church; burned at Smyrna. Polyclitus (pŏl-i-kW'tŭs) (5th century B.C.), Greek sculptor Doryphorus or Spear-Bearer G-166 statue of Hera H-281

Polycrates (pō-lik'rā-tēz), tyrant of olycrates (po-MeTa-tes), tyrant of Samos in 6th century B.C.; made Samos a leading political and commercial center; erected beautiful buildings; patron of art and literature; put to death by order of Oroetes, Persian governor of Lydia. Polydec'tes, in Greek mythology P-127,

128, picture P-127 Polygamy (pô-lig'à-mǐ), or polyg'yny, form of marriage F-8, 9 among nomads F-10

Mohammedanism M-214

Monammedanism M-214
Mormonism U-266, M-259, A-313
Turkey abolishes T-161
Polygnotus (pōl-t̄g-nō'tŭs), Greek
painter of 5th century B.C.; decorated public buildings in Athens;
master draftsman; among first to use varied expressions in faces.

Polygon, in geometry G-49 Polygonaceae (pŏl-i-ōō-nā'sō-ō), the buckwheat family of plants. Polyhalite, a mineral salt of calcium and magnesium M-183 Polyhymnia (pol-i-him'ni-a), in Greek mythology, Muse of hymns M-305, picture A-228

Polymeric amides P-2451, 246

Polymerization, the chemical union of two or more identical molecules into a larger molecule (polymer) which differs from the smaller ones (monomers) in its properties paints and plastics P-32a, P-245k

petroleum products P-150

rubber R-169a, 170, diagram R-169b Polynesia (pŏl-i-nē'shi-a), a division of the Pacific islands, chiefly east of longitude 170° E. and within 30° north and south of the Equator P-4-7, map P-10b-c

Polynesians P-4-5 brown race R-10, Outline R-12 Hawaiians H-244 Maoris N-136, picture N-135 Samoans S-20

Polynices (pol-i-ni'sez), in Greek mythology, son of Oedipus O-208

Polyno'mial, in algebra A-123, 124 Polyp (pöl'ip), a coelenterate animal resembling the common hydra (from Greek polypous, many-footed) coral C-364

bydra H-365-6 jelly-fish J-210, picture J-210 sea-anemone S-66

Polypet'alous plants, a division of the angiosperms; flowers have petals free from one another trees T-137

olyphemus $(p \ddot{o} l - \ddot{i} - f \ddot{e}' m \ddot{u} s)$, in the 'Odyssey', Cyclops from whom Odysseus escaped C-419 Polyphemus

Polyphemus moth, color plate B-285a-b

Polyphon'ic music M-309-10 Polypodiaceae (pöl-i-pō-di-d'sē-ē). See in Index Common-fern family

Polysac'charides, carbohydrates containing more than four sugar-like molecules S-322 cellulose C-123

glycogen (animal starch) B-110 gums G-188

starch S-276 Polystyrene, a synthetic resin P-2451, 246

Polytechnic Institute of Brooklyn, at Brooklyn, N.Y.; founded 1853; chemical, mechanical, civil, and chemical, mechanical electrical engineering.

Pol'ytheism, a belief in many gods, common in primitive religions; opposed to monotheism, the belief in one god

Ikhenaton abandons E-209

Polyxena (pō-lik'sō-nā), Trojan princess, daughter of Priam and Hecuba, and beloved of Achilles, greatest enemy of her people. According to Euripides' story, she was sacrificed by the Greeks on the pyre of Achilles, in explation for his murder by Paris: A-9

F

Car Carlotte

murder by Paris: A-9
Pombal (pōm-būl'), Sebastian Joseph
de Carvalho e Mello, Marquis of
(1699-1782), premier of Portugal
under King Joseph, called the
"Great Marquis"; expelled Jesuits,
rebuilt Lisbon after great earthquake 1775, reorganized army, education, and freed Indian slaves in
Brazil. Brazil.

Pome'granate, a tropical and sub-tropical tree and its fruit P-298-9 Pomegranate melon, a pink-fleshed watermelon; rind striped and mottled; about size of orange; grown chiefly for preserves.

Pom'elo, or grapefruit G-133-4

Pomera'nia, an agricultural province of Prussia on Baltic Sea; 11,665 sq. mi.; pop. 1,879,000; Oder River; sea

trade of which Stettin (capital) is center: map G-66 farm products G-66

Pomeranian, a toy dog D-83, picture

Pomo, a group of tribes forming the Kulanapan stock of Indians of California, noted for their basketry.

Pomo'na, Roman goddess of fruit autumn festival H-202

Pemena, another name for Mainland, largest of Orkney Islands O-251

Pomona, Calif., beautiful residential city and health resort, 30 mi. e. city and health resort, 30 mi. e. of Los Angeles; pop. 28,539; fruit-growing region, noted for oranges and lemons; knit goods, brick and tile, dairy products.

Pomona College, at Claremont, Calif.; founded 1887; classics, literature, science; included in Claremont Col-

Pompadour (pôn-pà-dgr'), Jeanne Antoinette Poisson, Marquise de (172 64); favorite and powerful political adviser of Louis XV of France pact in Seven Years' War S-84

Pom'pano, or pampano, a fish F-75 Pompeli (pom-pā'yō), Italy, ancient Roman city destroyed by an erun-tion of Mt. Vesuvius 79 A.D. P-299-302

archeological excavations P-300-1 destruction by volcano P-299-300 mosaics M-262

public and home life P-300-1 shelter P-300, pictures P-300, 301 soap found in S-175

Pom'pey, the Great (106-48 B.C.), Roman general, statesman P-302 Caesar and C-12, P-302 Jerusalem taken by J-217

Pompey's Pillar, Alexandria, picture A-116

Ponape (pô'nä-pā), largest island in Japanese mandate in Pacific, in e. Caroline Islands; 130 sq. mi.; Japanese naval base: map P-10b

Ponca, or Ponka, a tribe of Indians of Siouan stock living in early times about the mouth of Osage River, Mo. After many migrations they settled in Nebraska, but after wars with Sioux were sent to Indian Territory, now Oklahoma: I-54

Ponea City, Okla., city 77 mi. n.w. of Tulsa in rich oil section; pop. 16,794; oil and oil products, live stock, farm products; airport.

Ponce (pon'tha), 2d city of Puerto Rico, 8 mi. from s. coast; pop. 65,-182; tobacco manufactures; exports coffee and sugar from port at Playa de Ponce: P-311

Ponce de León (pōn'thā dā lā-ōn'), Juan (1460?-1521), Spanish ex-plorer; discoverer of Florida: P-802, F-109, map F-111 Puerto Rico, governor of P-311 search for Fountain of Youth P-302,

A-295

(pôn-kē-ĕl'lē), Ponchielli Amileare (1834-86), Italian composer; best known by opera 'La Gioconda'.

Poncho, cloak worn by American Indians and Spanish-Americans; resembles a blanket with hole in middle for head: S-206 gaucho wearing, picture S-206d Peruvian design, picture T-63

Penche, or ground cloth, for camping Pond.

Peter (flourished 1773-90) Canadian fur trader, born Milford, Conn.; 1778 established first trad-ing post in Athabaska country, 1783-91 partner in North-West Company.

Pond, Samuel W. (1808-91) Gideon H. (1810-78), bro brothers, Gideon H. (1 Congregational Congregational missionaries to Sioux Indians in Minnesota; established missions at Lake Harriet (1834), Oak Grove (1848), Prairieville (1847). They lived and worked with Indians, published speller, dictionary, grapmer, and worked with Indians, published speller, dictionary, grammar, cate-chism, readers in Sioux language; after 1853 served white settlers.

Ponderosa pine, an evergreen tree (Pinus pondcrosa) of the pine family. A variety of names have been applied to this tree including western yellow pine; its wood is called western pine, western white pine, California white, pondosa, yellow, Oregon white, bull, and blackjack nine.

Pondicherry (pon-di-cher'i), or Pon-dichery (pon-di-cher'i), French India, colony in s.e. on Coromandel Coast of India; about 110 sq. ml.; pop. 185,000; settlement dates from 17th century; several times taken by English; chief town Pondicherry (pop. 50,000), cap. of French India: I-43, maps I-31, A-332c

Pond-lily, or water-lily W-47-8. See also in Index Water-lily

Pond scum, a green alga A-120 Pondweeds, or pickerel weeds W-49 Pongee silk S-147

Shantung production S-102 Poniatowski (pôn-yä-tôf'skē), Joseph Anthony (1763-1813), Polish prince,

commander under Napoleon, and marshal of France; died fighting to cover French retreat after Leipzig; buried in 14th century cathedral in Cracow.

Ponka. See in Index Ponca

ons (pônz), Lily (born 1904), American coloratura soprano, born Pons Cannes, France, of French-Italian parentage; married André Koste-lanetz 1938; her voice, of unusual clarity and wide range, and her charming personality made her one of leading singers of Metropolitan Opera Company, New York City, and also successful in radio and motion pictures; became citizen of U.S. 1940.

Pons, of the brain, a bridge connecting the cerebrum, cerebellum, and medulla oblongata, picture B-220

Ponselle (pón-sel'), Rosa Melba (horn 1895), American operatic soprano, born Meriden, Conn., of Italian parents; gifted both as singer and as actress; joined Metropolitan Opera Company, New York City, 1918,

Ponta Delgada (pôn'từ dĕl-gử'dü), town on St. Michael Island, Azores; pop. 18,000,

Pontchartrain (pôn-shàr-trăn'), Louis Phelypeaux, Count of (1643-1727), French politician, minister of marine and colonies; Fort Pontchar-train at Detroit and Lake Pont-chartrain in Louisiana were named after him.

Pontchartrain (pon-char-tran'), Lake. salt water lake in s.e. Louisiana; length 36 mi., greatest width 22 ml.: map L-206 New Orleans canal N-100

Pont de Bordeaux (pôn dữ bôr-độ') B-194

Ponte Vecchio (pôn'tā věk'yō), bridge in Florence B-240, picture I-165

Pon'tiae (1720?-69), Ottawa Indian chief, organizer of "conspiracy of Pontiae" (1768-65) against British I-68, M-154, R-82

Pontiac, Mich., industrial city on Clinton River 25 mi. n.w. of De-

troit, in lake region with good hunting and fishing; pop. 66,626; trade in farm produce, fruit; automobiles and accessories, dies and tools, lumber products: map M-153 Pontianak (pŏn-tē-ä'nāk). See Jelutong

Pon'tifex Max'imus, one of the titles of the Pope; in ancient times, head of the College of Pontiffs, a body of high Roman priests whose duty was to preserve religious tradi-tions; title was also held by the emperor of Rome as the religious head of the state origin of title P-54

Pon'tine marshes, a swampy, malarial region in w. cent. Italy, between Rome and Naples I-160

Pon'tius Pi'late. See in Index Pilate Pontoon bridge B-240, picture B-242 army engineers build, picture A-307a Istanbul, picture I-153 Xerxes builds across

Hellespont P-135-6

F-130-6
Pontoppidan (pōn-tôp'i-thân), Henrik (1857-1943), Danish novelist, famous for his books on peasant life; shared Nobel prize in literature, 1917, with Gjellerup ('Village Tales'; 'From the Huts').
Pon'tus, ancient region in n.e. Asia

Minor on Black Sea; originally part of Cappadocia; kingdom founded 4th century s.c. increased in extent and power by Mithradates; conquered by Pompey the Great monastery of St. Basil M-232

Pony, a small breed of horse H-344 Indian H-344 nolo H-344

Shetland H-344, picture H-342

Pony express, a system of transport-ing mails by horses in relays across the western plains of the U. established 1860: F-17, T-1 pictures C-324b, T-123
Buffalo Bill and B-262

Poodle, a dog D-83

Pool, a common fund designed to control market price of stocks, grain, or other commodities; also a combination of competing business firms to control prices and traffic European combine, or cartel T-147

Pool, artificial formal garden, pictures G-6, 7, 8 rock garden G-9, 11

Pool, or pocket billiards B-109

Poole, Ernest (born 1880), American novelist, born Chicago, Ill.; correnovelist, norn Chicago, III.; correspondent for newspapers and magazines in Russia, Germany and France; studied social problems, New York and Chicago; forceful, realistic novels; awarded Pulitzer prize 1918 ("The Harbor'; 'His Family'; 'Blind'; 'Silent Storms').

Poole, William Frederick (1821-94), librarian, historian, born Salem, Mass.; founded Poole's Indem to Periodical Literature; head of Newberry Library, Cl his death: L-106f Chicago, 1887 until

Poo'na, or Puna, India, agricultural trade center 75 mi. s.e. of Bombay; healthful climate; pop. 250,000; summer seat of Bombay govern-ment: maps I-30, A-332c

Poor, Henry Varnum (born 1888), painter, born Chapman, Kan.; work original and modern; espe-cially noted for vital figure paint-ing and for powerful murals.

Poor Clares, or Franciscan Nuns, a religious order F-187, M-236

Poore, Henry Rankin (1859–1940), American painter and teacher of art, born Newark, N. J.; paintings include landscapes and skilfully

POPES OF THE ROMAN CATHOLIC CHURCH

Note: The dates are those given by the 'Catholic Encyclopedia'. Names of doubtful popes and antipopes are in brackets, thus []

		d dates are those given	by one Ca	mone Encyclopedia. N	ames of doubtful popes and and	tipopes are in brackets, thus [].
	died 67?	Peter Linus Anacletus Clement I Evaristus Alexander I Sixtus I (Xystus) Telesphorus Hyginus Pius I Anicetus Soter Eleutherius Victor I Zephyrinus Calixtus I Urban I Pontianus Anterus Fabian Cornelius Novatianus Lucius I Stephen I Sixtus II Dionysius Felix I Eutychianus Caius Marcellinus Marcellinus Marcellinus Marcellinus Marcellinus Marcellinus Melchiades Sylvester I	638-640	Severinus	996-999 Gregory V	1994 49 Daniella WIX
	67-79?	Linus	640-642	John IV	1997-998 John V 1711	1334-42 Benedict XII 1342-52 Clement VI 1352-62 Innocent VI
	79~90?	Anacletus	642-649	Theodore I	999-1003 Sylventor II	1352-62 Innocent VI
	90-99?	Clement I	649-655	Theodore I Martin I Eugenius I	1003 John XVII	1862-70 Urban V
	99-107?	Evaristus	654-657	Eugenius I	1003-09 John XVIII	1370-78 Gregory XI
	107-116?	Alexander I	657-672	Vitalianus	1009-12 Sergius IV	1378-89 Urban VI
	116-125?	Sixtus I (Xystus)	672-676	Adeodatus II	999-1003 Sylvester II 1003 John XVII 1003-09 John XVIII 1009-12 Sergius IV 1012-24 Benedict VIII 1024-32 John XIX 1032-45 Benedict IX 1045 Sylvester III 1045-46 Gregory VI	1342-52 Clement VI 1352-62 Innocent VI 1362-70 Urban V 1370-78 Gregory XI 1378-89 Urban VI [1378-94 Clement VII] 1389-1404 Boniface IX
	125-136?	Telesphorus	676-678	Donus	1024-32 John XIX	1389-1404 Boniface IX
	130-1407	Hyginus	678~681	Agathon	1032-45 Benedict IX	1394-1424 Benedict XIIII
	140-154?	Pius I	682-683	Leo II	[1045 Sylvester III]	1404-06 Innocent VII
	154-1057	Anicetus	684-685	Benedict II	1045-46 Gregory VI	1406-15 Gregory XII
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	917-999	Calintra I	705 707	John VI	1049-57 Leo IX	[1424 Benedict XIV]
	222-230	Urban I	709-101	John VII	1055-57 Victor II	1424 Benedict XIV) 1424-29 Clement VIII] 1431-47 Eugenius IV 1439-49 Felix V
	230-235	Pontionus	708-715	Constanting	1050 so Denediat V	1431~47 Eugenius IV
	235-236	Antorna	715_731	Crocow II	1000-00 Deficit A	[1430-49 Lenx A]
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	254-257	Stephen I	757-767	Paul I	1087 Victor III	1484-92 Innocent VIII
	257-258	Sixtus II	[767-768	Constantine	1088-99 Urban II	1492-1503 Alexander VI
	259-268	Dionysius	768-772	Stephen III	1099-1118 Paschal II	1503 Pins III
	269-274	Felix I	772-795	Adrian I	[1105-11 Sylvester IV]	1503-13 Iulius II
	275-283	Eutychianus	795-816	Leo III	1118-19 Gelasius II	1513-21 Leo X
	283-296	Caius	816-817	Stephen IV	[1118-21 Gregory VIII]	1522-23 Adrian VI
	296-304	Marcellinus	817-824	Paschal I	1119-24 Calixtus II	1431-47 Eugenius IV [1439-49 Felix V] 1447-55 Nicholas V 1445-58 Calixtus III 1468-64 Pius II 1464-71 Paul II 1471-34 Sixtus IV 1484-92 Innocent VIII 1492-1503 Alexander VI 1503-13 Julius II 1503-13 Julius II 1513-21 Leo X 1522-23 Adrian VI 1523-34 Clement VII 1534-49 Paul III 1550-55 Julius II 1555-59 Paul IV
	308-309	Marcellus I	824-827	Eugenius II	1124-30 Honorius II	1534-49 Paul III
	309 or [3]	[0] Eusebius	827	Valentine	[1124 Celestine II]	1550-55 Julius III
	311-314	Melchiades	827-844	Gregory IV	1130-43 Innocent II	1555 Marcellus II
	314-335	Sylvester I	844-847	Sergius II	[1130-38 Anacletus II]	1555-59 Paul IV
	227 250	Warcus	1055	Leo IV	11138 Victor IV	1559-05 Pius IV
	252.266	Julius I Tibarina	955 959	Benedict III	1087 Victor III 1088-99 Urban II 1099-1118 Paschal II [1105-11 Sylvester IV] 1118-19 Gelasius II [1118-21 Gregory VIII] 1119-24 Calixtus II 1124-30 Honorius II [1124 Celestine II] 1130-43 Innocent II [1130-83 Anaeletus II] [1138 Victor IV] 1143-44 Celestine II 1144-45 Lucius II	1555-59 Janus II 1555-59 Marcellus II 1555-59 Paul IV 1566-72 Pius V 1572-85 Gregory XIII 1585-90 Sixtus V 1590 Urban VII
	1355-365	Foliv III	858-867	Nicholas I	1145-53 Eugenius III	1505 On Circum V
	366-384	Domagna I	867-872	Adrian II	1145-53 Eugenius III 1153-54 Anastasius IV	1500 Yirkan VII
	384-398	Sirioina	872-882	John VIII	1153-54 Anastasius IV 1154-59 Adrian IV 1159-81 Alexander III [1159-64 Victor IV] [1164-68 Paschal III]	1590 Urban VII 1590-91 Gregory XIV 1591 Innocent IX 1592-1605 Clement VIII 1605 Leo XI 1605-21 Paul V 1621-23 Gregory XV 1623-44 Urban VIII 1644-55 Innocent X 1655-67 Alexander VII 1667-69 Clement IX 1670-76 Clement X 1676-39 Innocent XI
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	402-417	Innocent I	884-885	Adrian III	11159-64 Victor IVI	1592-1605. Clement VIII
	417-418	Zosimus	885-891	Stephen V	[1164-68 Paschal III]	1605 Leo XI
	418-422	Boniface I	891-896	Formosus	[1168-78 Calixtus III]	1605-21 Paul V
	422-432	Celestine I	896	Boniface VI	[1179-80 Innocent III]	1621-23 Gregory XV
	432-440	Sixtus III	896-897	Stephen VI	1181-85 Lucius III	1623-44 Urban VIII
	440-461	Leo I	897	Romanus	1185-87 Urban III	1644-55 Innocent X
	461-468	Hilarius	897	Theodore II	1187 Gregory VIII	1655-67 Alexander VII
	468-483	Simplicius	898-900	John IX	1187-91 Clement III	1667-69 Clement IX
	483-492	Felix II (III)	900-903	Benedict IV	1191-98 Celestine III	1670-76 Clement X
	492-490	Gelasius I	908	Leo Y	1195-1210 Innocent III	1070-89 innocent Al
	400 514	Anastasius II	903-904	Caristopher	1159-81 Alexander III [1159-64 Victor IV] [1164-68 Paschal III] [1168-78 Calixtus III] [1179-80 Innocent III] [1181-85 Lucius III [1181-85 Urban III [1187-91 Clement III [1191-98 Celestine III [1191-98 Celestine III [126-27 Honorius III [1227-41 Gregory IX [1241 Gelestine IV [1243-1254 Innocent IV	1601 1700 I
	#Y0~014	Jymmacaus Hermiedes	903-911	Amagtacina III	1241-41 Gregory IA	1700 21 Clamant XI
	509 526	Toba I	013-014	Lando	1243-1254 Innocent IV	1721-24 Innocent XIII
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	533-535	John II	928-931	Stephen VII	1265-68 Clement IV	1740-58 Benedict XIV
	535-536	Aganetus I	931-936	John XI	1271-76 Gregory X	1758-69 Clement XIII
	536-538?	Silverius	936-939	Leo VII	1276 Innocent V	1769-74 Clement XIV
	538?-555	Marcellinus Marcellinus Marcellinus Marcellinus Marcellinus Melchiades Sylvester I Marcus Julius I Liberius Felix III Damasus I Sirioius Anastasius I Innocent I Zosimus Boniface I Celestine I Sixtus III Leo I IIII IIII IIII Gelasius I Anastasius I Simplicius Felix II (III) Gelasius I Anastasius I Symmachus Hormisdas John I Felix III (IV) Boniface II John II Agapetus I Silverius Vigilius Pelagius I John III Benedict I Pelagius II Gregory I, the Great Sabinianus Boniface III	939-942	Stephen VIII	1276 Adrian V	1775-99 Pius VI
	556-561	Pelagius I	942-946	Marinus II	1276-77 John XXI	1800-23 Pius VII
	561-574	John III	946-955	Agapetus II	1277-80 Nicholas III	1823-29 Leo XII
	575-579	Benedict I	955-964	John XII	1281-85 Martin IV	1829-30 Pius VIII
	579-590	Pelagius II	1963-965	Leo VIII]	1285-87 Honorius IV	1831-46 Gregory XVI
	590-604	Gregory I, the	964-965	Benedict V	1288-92 Nicholas IV	1040-78 Plus IX
		Great	965-972	John XIII	1294 Gelestine V	1002 14 Pine V
	604-606?	Sabinianus	973-974 [974	Denedict VI	1202 Of Remediat VI	1014_99 Banadiat VV
	607	Boniface III	1974 00°	Boniface VII] Benedict VII	1805-14 Clament V	102230 Pina XI
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arranged groups of human figures with animals; author of 'Pictorial Composition and the Critical Judgment of Pictures'.

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Poor Richard's Almanac' by Benjamin Franklin A-176, C-23

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Burbank's sorghum pop, picture B-277

pe. See also in Index Papacy; Vatican; and individual popes by Pope. name. For list see table above

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Pope, Alexander (1688-1744), English poet P-303, E-285, picture E-285 birthplace L-186 Dryden influences D-115

quoted on Shakespeare S-100c Swift's friendship with S-343 translation of Homer B-191 verse form used P-270, P-303 Pope, John (1822-92), American Civil

War general; commanded Federal

Army of Virginia in 2d battle of Bull Run; resigned after defeat with Foote C-254

John Russell Pope, (1874-1937) American architect, born New York City; designed many notable public buildings and private residences Jefferson Memorial, picture J-207 National Gallery of Art, picture

Pope, Nathaniel (1784-1850), American politician; delegate from Illi-nois Territory, persuaded Congress to set boundary farther north in-cluding site of Chicago; father of General John Pope: 1-18 Popes Creek, Va., Washington's birthplace W-13

Popham, George (1550-1608), English colonist, attempted to settle Maine (1607): M-40

Popinjay, a name often given to the green woodpecker found in Eng-land and Scotland; in Middle Ages parrots were so called, hence it is sometimes applied to an archer's target made in the shape of a parrot.

Poptsh Plot, plan alleged to have been discovered between 1678 and 1680 by Titus Oates. He made repeated efforts to prove by false testimony and forged papers that the Queen and some of the leading English Catholics were plotting to murder Charles II and restore Catholicism as the state religion; popular feeling ran high; a number of Jesuits and other Catholics were executed.

Pop'lar, a genus of trees P-303-4 Greek myth P-157 name applied to tulip tree T-150

pest: satin moth I-90

Poplar Bluff, Mo., city on Black River, 180 ml. s. of St. Louis; pop. 11,163; seat of Butler County; railroad shops, woodworking plants, shoes, printing, foundry, gravel and clay industries, important center for farm trade: map M-208

Pop'lin, a fabric with a warp of silk and a heavier filling of worsted, cotton, or linen, which gives the material a corded surface; name comes from "Pope," for the fabric was first manufactured at Avignon, a papal residence in the 14th century.

opocatépetl (pō-pō-kë-tā'pēt-l), Mount, volcano about 40 ml. s.e. of Mexico City; one of highest peaks in North America (17,887 ft.); crater yields sulphur; violent erup-tions 1821, 24, 1921, per 24, 1921 Popocatépetl tions 1921: M-132b, map M-133

oppaea Sabina (pop-ë'à sà-bi'nà) (died 65 A.D.), mistress, later wife, of Nero; beautiful but unscrupu-Poppaca lous; influenced Nero to murder his mother Agrippina and his wife Octa-via; was later killed by a kick from Nero.

Popping crease, in cricket C-395 Poppy, a flowering plant P-304 California poppy G-10, P-304 Iceland poppy G-21 optum poppy O-234-5 Oriental poppy G-11 planting, when and how G-7, 10,

plume poppy G-10 Shirley poppy G-11

Poppy family, or Papaveraceae (pā-pāv-ēr-ā'sē-ē), a family of plants and shrubs, including the plume-poppy, celandine, California poppy, flaming-poppy, poppy, cream-cups, blood-root, celandine-poppy, argemone, tree-poppy, and sea-poppy.

Poppyfish. See in Index Butter-fish Poppy-mallow, a genus of annual and perennial plants (Callirhoe) of the mallow family with pink or red-purple flowers in terminal clusters; native to North America.

Popular Sovereignty, or Squatter Sovereignty, in American history, doctrine that inhabitants of a territory had right to regulate their internal affairs without interference by national government Kansas-Nebraska Act K-7

Lincoln-Douglas debates L-145

Population P-304-304d. See also in Index Immigration; Negro. For population of continents and politi-

cal divisions, see in Index Africa; France; etc. altitude affects, pictograph E-145d

alfitude affects, pictograph E-145d census C-128-30, U-212, W-101 center U-196: cause of shift L-61d density P-304b, P-310: China and U. S. compared, pictograph C-213 distribution: in U. S. U-196, 198; in world, map P-304c future in U. S. L-61b growth P-304, 304b; law of B-119; rates of birth and death, pictogensial pictogensial

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 $(p \delta k - l \check{a} \check{n}'),$ Jean-Baptiste Poquelin (1622-73), real name of Molière M-217-18, picture F-195

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watch dials W-40

Porch, in architecture A-168

Por cupine, a rodent characterized by quill-like spines P-304d, picture

Porcupine-fish, sluggish fish of family Diodentidae; olive-colored with black spots; squarish or spherical coty about 2 ft. long, protected by splnes lying close to body when fish is at ease; when disturbed body inflates with water or air and splnes erect much like those of manual procuping porcupine.

Porcupine Mountains, range in western Michigan, bordering La Superior; highest point 2023 ft. Lake Porcupine River, in e. Alaska, tribu-

tary of Yukon, maps A-105 Pore, minute opening, or duct, in the

skin through which gland secretions reach the surface S-157

Porgy, world-wide family of marine food fishes (Sparidae); deep, oval, compressed bodies, of reddish color. Scup of N. America and sacred red tai of Japan belong to this family.

Porif'era, the sponge phylum of ani-mals S-262, Z-227

Pork, uncured meat of hog; known as ham or bacon when cured H-314-16 certain religions prohibit M-214

export trade H-316
packing house operations M-97;
smoking and curing H-316
trichinosis infection W-180b, H-316

Porkfish, a beautifully colored fish of the grunt family; important as a food-fish in the West Indies.

Porkop'olis, nickname for Cincinnati. Ohio C-236

Pork tape worm W-180a

Porphyry (pôr'fi-ri), an igneous rock L-73, R-121 Perpoise (pôr'pôs), a marine mammal

-305 Por'sena, Lars, or Porsen'na, in Roman legends, king of Clusium Etruria R-130, T-88

Porson, Richard (1759-1808), one of the greatest English classical scholars of all times; born Norfolk; notes and emendations on Aeschylus, Aristophanes, and other Greek authors.

Port. See in Index Harbors and ports

Port, the left side of a boat; formerly called larboard.

Port, wine, origin of name, picture P-313

Porta del Popolo (pôr'tä děl pô'pō-lō), one of gateways to Rome R-144

one of gateways to Rome R-144

Portage (pōrt'āġ), Wis., manufacturing city 35 mi. n. of Madison on canal connecting Wisconsin and Fox rivers; pop. 7016; railroad shops; hosiery, shoes; marble works: map W-124

early route through W-122

Portage, method of transfer C-75

Portage la Prairle (pôr-tázh' là prê-rē'), Manitoba, Canada, railroad and distributing center 55 mi. w. of Winnipeg in wheat section; summer resort; pop. 6538: map C-50b

Portal, Sir Charles Frederick A. (born 1893), made chief of Britain's Air Staff 1940, formerly director of organization of Air Ministry.

Portal vein L-165

Port Angeles, Wash., city in n.w. on strait of Juan de Fuca; pop. 9409; lumber, wood products, paper, dairy products: 2d national city in U. S. having been set aside as a government townsite during Linlumber, coln's administration: map W-29

Port Arthur, strongly fortified naval station in Kwantung Leased Territory, s. Manchukuo; pop. 145,000; M-52, maps M-49a, J-186 Russo-Japanese war R-198

Port Arthur, Ontario, city at head of Lake Superior, 3 mi. from sister city of Fort William; grain and coal-shipping center of w. Canada; pop. 19,818: F-161, map C-500 grain elevator, picture C-52

Port Arthur, Tex., trade center and seaport in extreme s.e. of state on Sabine Lake, connected with Gulf of Mexico by Port Arthur Ship. Canal; pop. 46,140; oil-refining cen-ter; railroad shops, iron works; Port Arthur College.

Port Augusta, South Australia, sea-port and railway terminus on Spencer Gulf; pop. 8000; map A-372a

Port au Prince (pôr to prans), capital and principal seaport of Haiti, West Indies, on w. coast; pop. 105,000: H-198, map N-1500, picture H-197

Port Chester, N. Y., village and summer resort on Long Island Sound, 26 mi. n.e. of New York City; pop. 23,073; bolts and nuts, shirts, clothing, candy, brushes.

Port Colborne, Ontario, Canada, town and port on Lake Erie and Welland Ship Canal; pop. 6503; nickel refinery, flour mills, government elevator: W-70, map, inset C-50b government Portcul'lis. of castle C-94

Port Dalhousie (dăl-ho'sē), Ontario, Canada, town and port on Lake Ontario, near e. terminus of Welland Ship Canal; pop. 1547; rubber factory, canneries, shipyard and dry dock: W-70

Port Darwin, sheltered inlet forming the harbor of the city of Darwin, Northern Territory of Australia; naval base: map A-372a

Port Durnford, port on Indian Ocean, Kenya Colony, e. Africa, map E-139 Port du Salut (pôr dù sälù'), a cheese. See Trappist cheese

Porte, Sublime, The, Turkish government, so called from high gate giving access to building containing state department offices.

Portée artillery, in army A-807c Port Elizabeth, Union of South Africa, the 2d city of Cape of Good Hope province; seaport 400 mi. e. of Cape Town; pop. 110,000 (including 54 000 Europeans); large trade; University of South Africa: map A-42a

Porter, David (1780-1843), American naval officer in war with Tripoli (1801-03) and War of 1812; commander of Mexican naval forces 1826-29; father of David Dixon Porter.

Porter, David Dixon (1813-91), American naval officer P-305

Porter, Eleanor H. (1868-1920), American author, born Littleton, N. H. ('Pollyanna', one of most popular of the "glad books").

Porter, Gene Stratton (Mrs. Charles Darwin Porter) (1868–1924), American novelist, naturalist; born Wabash Co.; Ind.; studied nature, contributed photographs, drawings to magazines; famous for novels of outdoor life ('Freckles', 'A Cirl of the Limberlost'; 'The Harvester').

Porter, George Byron (1791-1834), American politician, born Morristown, Pa.; third governor territory of Michigan 1831-34.

Porter, Jane (1776-1850), English writer famous for vivid and con-vincing historical novels ("Thad-deus of Warsaw'; 'Scottish Chiefs'; "The Field of Forty Footsteps').

Porter, Noah (1811-92), American educator; president Yale University (1871-76); editor of Webster's and other dictionaries ('The Human Intellect'; 'Books and Reading').

Porter, Pleasant (1840-1907), half-breed Creek Indian chief, born Oklahoma; served South in Civil War; ably led his people through difficult period of readjustment.

Porter, William Sydney (O. Henry) (1862-1910), American short-story writer P-305-6

Porterhouse, a cut of beef, picture

Portes Gil (pôr'tās hēl), Emilio (born 1891), Mexican political leader; served as judge of lower and superior courts; deported to State of Chihuahua (1919) for activities in support of Obregon; as governor of Tamaulipas (1925-28), promoted interests of farmers and laborers; secretary of interior and head of cabinet under President Calles, 1928; provisional president 1928-80: M-142f

Port Florence, Kenya Colony, Africa, port section of Kisumu; terminus on Lake Victoria of Uganda railway: map H-139

Port Gibson, Miss., town 80 mi. s.w. of Vicksburg; pop. 2748; here Ad-miral D. D. Porter ran the Vicks-

burg batteries Apr. 16, 1863, and General Grant defeated the Confederates May 1, 1863.

Porthos (pôr-tôs'), one of the "Three Musketeers" of Dumas's novel; noted for size, strength, and fondness for display

ort Hudson, La., village 18 mi. above Baton Rouge on Mississippi River; captured by Union forces under General Banks July 9, 1863: map C-253

Port Huron, Mich., port on St. Clair and Black rivers at foot of Lake Huron; pop. Canadian trad 32,759; extensive trade; connected Sarnia, Ontario, by railroad tunnel, ferry service, and Blue Water International Bridge; salt, automobile parts, wire, paper; railroad shops; summer resort: map M-153

Portia (pôr'shi-à), heroine of Shakespeare's 'Merchant of Venice' M-119 Portico style, in architecture A-272

Portina'ri, Candido (born 1903), Brazilian painter, born São Paulo, Brazil, son of an Italian coffee worker; uses ultra-modern as well as classical styles; murals, por-traits, and pictures of Brazilian life, especially life among Negroes.

Port Jervis, N. Y., a railroad center and summer resort on Delaware River 60 mi. n.w. of New York City, at junction of New York, New Jersey, and Pennsylvania boundaries; pop. 9749; railroad shops; silverware plate, gloves, glass, silk: map N-114

Portland, Me., largest city and chief seaport in state on Casco Bay 50 ml. s.w. of Augusta; pop. 78,643; paper, lumber products, fish; burned by British 1775: M-39, map M - 38

great fire F-58

Portland, Ore., largest city of state; pop. 305,394: P-308-7, map O-246, pictures O-247 seaport created C-316

Portland, Isle of, peninsula on coast of Dorsetshire, England; noted for huilding-stone

portland cement named for C-125 Portland, University of, at Portland, Ore.; Roman Catholic institution, founded 1901; arts and sciences, business administration, nursing, graduate school.

Portland cement C-124-8

Portland vase, beautiful dark blue glass urn with figures in white; found in tomb near Rome; broken by a madman in 1845 but skilfully repaired; long exhibited in British Museum: G-106, picture E-336 copied in Wedgwood ware P-332

Port Louis, capital of Mauritius; pop. 55,000.

Port Mahon. See in Index Mahon

Port Moresby (morz'bi), New Guinea, capital of Territory of Papua and seaport on s.e. coast; pop. about 2000: map P-10b

Port Natal. See in Index Durban

Port Nelson, Manitoba, Canada, town at mouth of Nelson River on Hud-son Bay: map C-50b

Port Newark Terminal N-80

Porto (pôr'tō), Portugal, also Oporto, 2d city, seaport and commercial center on Douro River, 2 mi. from 235,000; textiles. sea; pop. wine: P-312, 313, map E-326d

Porto Alegre (å-là'gra), port and capital of state of Rio Grande do Sul, Brazil, near n. extremity of Lake Patos in agricultural and

grazing country; pop. 840,000; German colony handled most of com-merce before 1st World War; merce before 1st World B-227, maps B-228, S-208c

Porto Bel'lo, port on Atlantic coast of Isthmus of Panama 20 mi. n.e. of Colon; pop. about 1000; early shipping point: P-42

pack-train terminus P-43, picture C-133d

Port of call, port at which vessels are accustomed to stop for repairs, supplies, or similar requirements.

Port of entry, any point, whether on the frontier or not, designated by the customs authorities as a place where merchandise or persons may fulfil the legal requirements for entering or departing from a country. Need not be a nautical port.

Port of Spain, capital of Trinidad; pop. 90,000: T-142

Porto Grande (pôr'tō grān'dā), port and commercial center of Cape Verde Islands C-81

Portolá (pôr-tō-lä'), Gaspar de, 18thortola (por-to-la'), Gaspar de, 18th-century Spanish explorer; governor of California (1769-71); discovered San Francisco Bay (1769) while searching for Monterey Bay after long, hunger-tortured march from Lower California; founded San Diego and Monterey missions and presidios

Portolano, navigator's chart N-50

Port Orford cedar, evergreen tree (Chamaeoyparis lawsoniana) of (Chamaeoyparis lawsoniana) of pine family, native to small area in Oregon and California, sometimes called Lawson's cypress, Oregon called Lawson's cypress, capa-cedar, and white cedar; many varieties used as ornamental tre Grows 125 ft. to 200 ft., lives yrs.; pyramid-shaped, with sharply drooping branches. Wood fine, straight grained, pale brown, of moderate hardness, strength and lightness, with spicy odor; Oregon cedarwood oil distilled from wood, used in insecticides. Lumber important source for slats of Venetian blinds, battery separators, boats, blinds, battery ser and block matches.

Porto-Riche (pôr-tō-rēsh'), Georges de (1849-1930), French dramatist, born Bordeaux; his plays are studies of the emotions of men and women in love ('La Chance de Françoise'; 'Le Passé'; 'Le Vieil Homme'; 'Le Marchand d'Es-Homme'; 'Le Marchand d'us-tampes'; 'L'Infidèle'; 'Amoureuse').

Porto Rico, officially Puerto Rico (pwěr'tō rē'kō), island of West Indies, ceded to U. S. by Spain in 1898; 3435 sq. mi. (with nearby islets); pop. 1,869,255; cap. San Juan: P-307-11, maps W-72c, N-150c climate P-309-10 coat-of-arms F-93, color plate F-87

education P-309 forests, national, table F-250 government P-310, U-232 name, origin P-307, 311 people P-307

population problem P-310 products P-307-8: pineapples P-221 U. S. acquires P-310, S-235 U. S. naval bases N-52, map N-51

Porto San'to, a rugged island of Madeira group, 26 mi. n.e. of Madeira; about 17 sq. mi.; pop. 2000.

Port Republic, Va., village on Shenan-doah River 90 mi. n.w. of Rich-mond: here Confederates under "Stonewall" Jackson defeated Federals under Gen. Shields June 9, 1862.

Port Royal, Nova Scotia, former name of Annapolis Royal; founded (1605) by Champlain,

Port Royal, S. C., first settlement in South Carolina; pop. 342: S-214, map S-213

Ports H-214-17. See also in Index Harbors and ports

Port Said (sä-ēd'), Egypt, at n. end of Suez Canal; pop. (with Ismailia) 125,000; founded as coaling station 1859; exports cotton; attempt of Turks during 1st World War to capture city and wreck canal failed: S-317, maps A-42a, A-242

Portsea, England, naval station P-311 Portsmouth (ports'muth), England, great English naval station and arsenal, 74 mt. sw. of London; pop. 250,000: P-311, map E-270a

Portsmouth, N. H., seaport, resort and manufacturing city on Piscataqua River 3 mi. from Atlantic; pop. 14,821; shoes, buttons, gypsum products; coal-distributing point: map N-86. See also in Index Portsmouth Navy Yard (New Hampshire)

Portsmouth, Ohio, city on Ohio and Scioto rivers, and at s. end of Ohio Canal; pop. 40,466; agricultural and mining region; steel and iron products, shoes, brick; railroad shops:

man O-210

Portsmouth, Va., city in s.e. on Elizabeth River opposite Norfolk; pop. 50,745. First settled 1664, incorporated as town 1752, chartered as city 1858; landing place and base for British invading expeditions during Revolutionary War. Norfolk Navy Yard (first called Gosport Navy Vard), owned first by British. Navy Yard (hrs. canted Gosport Navy Yard), owned first by British, later by state; purchased by U.S. government 1901; Chesapeake, first ship built by Federal govern-ment, built here 1799, Merrimac prepared here for famous fight with Monitor. City held for a year by Confederates during Civil War. Naval Hospital, opened 1830: N-149, map V-306

Portsmouth, Treaty of (1905), terminated Russo-Japanese War R-198

Portsmouth Navy Yard (New Hampshire), on Fernald's and Seavey's islands near e side of Piscataqua River, connected by bridge with Kittery, Me; established 1800; builds and repairs submarines and smaller surface craft.

Portsmouth Navy Yard (Virg See in Index Portsmouth, Va. (Virginia).

Port Stanley, Ontario, Canada, village and harbor on Lake Erie, 23 mi. s.

of London; pop. 816. Portugal, republic of s.w. Europe; 84,604 sq. ml.; pop. 7,000,000; cap. Lisbon: P-312-15, maps S-226, E-326c, d, f, Outline S-234 bibliography S-234

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Far East explorations: Ceylon C-137; East Indies E-141, 142f; Japan

J-191a: Malay Peninsula M-43 Lisbon earthquake (1755) E-136, L-156

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C-365-6 shelter P-313, pictures P-312, 315

ships: caravel of 1450, picture S-125 transportation P-313

Portugal, University of P-314 Portuguese East Africa. See in Index

Mozambique

Portuguese Guinea, colony on w. coast of Africa enclosed on land side by French territory; includes adjacent Bissagos (Bijagós) Islands; 13,940 sq. mi.; pop. 380,000; cap. Bolama; chief port Bissao; trade in rice, wax, hides: map A-42a

Portuguese in America

discovery, exploration A-142-3, 144 Portuguese India, colony of Portugal in w. India; consists of three widely separated possessions, Goa, Damão (Daman), and Diu; total area of colony, 1537 sq. mi.; pop. about 600,000; cap. Panjim (also called Nova Goa) situated in Goa; commerce in coconuts, copra, fish, spices, nuts, salt: maps A-332c, I-31

ortuguese language and literature P-314, R-128 alphabet, special letters, table A-434

Brazil L-67u

Portuguese man-of-war, a jelly-fish; has long tentacles, powerful stinging organs; found in warm or tropical seas, chiefly in Gulf Stream.

Portuguese West Africa. See Angola Portuguese (200-40-1014)

Portulaca (pôr-tú-lăk'à), a genus of fleshy herbs of the pursiane family with small succulent leaves and yellow, red, or purple flowers which open only in sunshine.

Portulacaceae (pōr-tū-lā-kā'sē-ē). See in Index Purslane family

Port Weller, Ontario, the e. terminus of Welland Ship Canal: W-70

Posada (pō-sử/thử), Christmas Eve pilgrimage in Mexico C-229c Poseidon (pō-sử/dôn), in Greek my-thology, god of the sea P-315, U-261 Athena A-353

Cassioneia offends P-128 Cretan bull H-282

Odysseus C-419, O-205 temple, picture A-259 Posen (pō'zēn), Poland. See Poznan

Posey, Alexander L. (1873-1908), half-breed Indian poet, journalist; (1873-1908), born Oklahoma; from Creek mother learned folklore found in his poetry; editor, Muskogee Times, Indian Journal: member, lower house of Creek legislature (1895-97), active in affairs of Indian Territory.

Positive, in photography motion picture film M-280, picture M-286

Positive degree, in comparison of adjectives A-21

Positive electricity E-220, 221, E-241 pole, in electrical apparatus E-221, E-215

radiation R-16

Positive numbers A-122 Positive pole, of magnet E-227

Positive rays E-243

Pos'tivism, system of philosophy founded by Auguste Comte, which tried to organize all knowledge so as to form a basis for a science of society and a religion of humanity; rejected metaphysical inquiries. Positron, in physics P-195, A-362 Possessive case, in grammar N-179 Possum-wood. See in Index Monkey dinner-bell

Post, Emily Price (born 1873), American magazine contributor and writer on etiquette, born Baltimore, Md.; began as writer of novels contrast-ing European and American social customs; most popular work Eti-

Post, Wiley (1900-35), American aviator, famous for round-the-world flights; killed on flight in Alaska: picture A-72, table A-74

Post, army U-224 Postage, rates of P-320, 322 Postage stamps S-267-9

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P-322 Postal savings bank P-318, 320, B-40

established under Taft T-3 Postal service. See in Index Postoffice and postal service

Postal Union, Universal P-323 monument commemorating, picture

P-323 ostern (pōs'tērn) gate, of castle C-94, picture C-93 Postern

Post exchange. See in Index Canteen Postilion T-124

Post-impressionism, in painting P-24.

examples: 'Boy with the Red Vest', by Cézanne, picture P-26; 'L'Arlésienne', by Van Gogh, picture P-26

Post-impressionism, in sculpture S-62 Post oak, tree (Querous stellata) of beech family, native from Massa-chusetts to Gulf of Mexico, w. to Texas. Grows to 100 ft.; trunk Texas. Grows to 100 ft.; trunk short; branches spreading; leaves 6 in. to 8 in. long. Wood used for railroad ties and construction work.

Postoffice and postal service P-316-23 African postman, picture A-36 air mail. See in Index Air mail censorship: fraudulent advertising

A-24 classes of mail matter in U.S. P-322

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President U-221

Posture, correct H-376 how to acquire P-187, pictures P-187 reflexes governing R-63

Postwar planning W-1799-180, N-13 Potaro River, in British Guiana, 135-mi. tributary of the Essequibo; famous for its great Kaiateur Falls: picture S-206b Pot'ash, term for potassium carbon-

ate and certain other compounds

of potassium P-323-4

caustic (potassium hydroxide) P-323, 324, A-9 fertilizers F-27 glass manufacture G-101 sources P-323-4, M-183, 184: California P-323; Dead Sea P-34; Germany G-69; Nebraska N-58; New Jersey greensand M-184, N-92; seaweed S-73 Potus'sium, a metallic element (called in Latin and chemical formulas Kalium) of the alkali group P-323-4, C-175, 168

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bichromate or dichromate, for hardening gelatin C-231 bitartrate (cream of tartar) T-14, B-15

carbonate (potash) P-323, 324. See also in Index Potash chlorate, in match tips M-86

chloride P-324, M-183 cyanide C-418, P-324: gold extraction, action G-112; poisonous property P-275

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nitrate (saltpeter) S-18, N-146: in gunpowder G-188-9; mineral form M-183

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Potassium perman'ganate, compound of potassium, manganese, and oxygen C-175

antiseptic value M-53 gas masks contain G-25

Potato P-324-6 Burbank improves B-276 food value P-324-5: starch S-276, P-324, 325; vitamin content P-325;

water content P-324 fuel alcohol made from P-325 improvement A-53, B-276 international trade, pictograph

I-110e Ireland's staple food P-324 origin A-148, P-324

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tuber B-269, picture N-30 weight of bushel W-69 yield per acre P-324 Potato, sweet S-341-2

when and how to plant G-13 vam S-341

Potato-bug P-326 sprays used P-326, S-262, 263

Potato lenf roll, a virus disease of potato plants I-90 Potato starch S-276

Potawatomi (pō-tä-wä'tō-mī), Indi-an tribe of Algonquian stock; originally dwelt about Green Bay; moved to upper Wabash River and west into Illinois; retreated into Iowa and Kansas, also as far north as Canada, during Indian wars; finally removed to Indian Territory Fort Dearborn massacre C-192

Poten'tial, electric E-220

Potential difference, or electromotive force (E.M.F.) E-220, 222 electric cells produce E-239

Potential energy, in physics P-191, E-266

Potentilla. See in Index Cinquefoil Po'ti, U. S. S. R., seaport in republic of Georgia on Black Sea, 35 mi. n. of Batum; pop. 17,000; exports manganese, grain, timber: map P. 154 B-154

otiphar (pŏt'i-fär), an Egyptian official, whose wife tempted Joseph, Potiphar his slave (Gen. xxxix, 1): J-227

Potlatch, Idaho, small town in n. near w. border on Palouse River; formerly a thriving lumbering center.

Potlatch, an Indian ceremony I-56, picture I-68

Pot marigold, or calendula M-64

'Pot of Basil', or 'Isabella', painting by Alexander, picture P-29

Potomac (pō-tō'mak), Army of the, the principal Federal army in Amer-ican Civil War Grant leads G-132

Lincoln and generals of, picture L-143

McClellan reorganizes M-3 Meade heads M-95 Sheridan commands cavalry S-114,

115 Potomac Park, Washington, D. C.

W-26 Potomac River, in e. United States, flowing into Chesapeake Bay: P-326, map V-306 bridge, Arlington Memorial, picture B-243

early route to west U-183 Great Falls P-326, picture M-79 navigation: disputes U-206; Wash-ington promotes W-17 Washington shore line W-20

Potosí (pō-tō-sē'), silver- and tin-mining city of Bolivia on n. slope of Cerro de Potosi, 47 mi. s.w. of Sucre; pop. 35,000: B-169, map S-208b tin mine near, picture L-67n

Potsdam, Germany, historic city, garrison post, and capital of province of Brandenburg on Havel River 16 mi. s.w. of Berlin; pop. 67,000; national observatory: map G-66 palace, picture G-68

Potsherd (pot'shûrd), a fragment of a broken earthen pot ballot in ancient Greece A-283

Potstone, a form of tale T-6

Potter, Beatrix, English author and illustrator of children's books; her many works include the 'Peter Rabbit' series, 'The Fairy Caravan', 'Roly Poly Pudding'; first illustrated Peter Rabbit story published in 1901: L-108

Potter, Henry Codman (1835–1908) American Protestant Episcopa Episcopal bishop; born Schenectady, N. became bishop of New York, 1887; cathedral of St. John the Divine, New York City, begun during his episcopate; active in work for betterment of industrial conditions.

Potter, Paul (1625-54), foremost Dutch animal painter and etcher; famous for truthful representation of animals.

Potteries, The, name given to district of n. Staffordshire, England, chief seat of china and earthenware in-dustry; includes several towns, united in 1910 as one municipal borough (Stoke-on-Trent).

Potter's wheel T-111 Pottery P-327-35. See also in Index Clay; Porcelain and chinaware Aegean A-27, picture A-26 America, when first made in B-62 appreciation P-334

Bronze Age, picture M-47

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Mexican, picture M-139 Persian P-331, pictures P-333 purple of Cassius G-114 Roman, pictures R-133

Stone Age bowl, picture S-292 U. S. P-334, picture P-335: Ohio P-334, O-212; Trenton, N. J. T-138 Pottstown, Pa., industrial borough on Schuylkill River 35 ml. n.w. of Philadelphia; pop. 20,194; agricul-tural region; iron and steel prod-ucts, silk, knitted goods; Hill

ucts, silk, kni School for boys. Pottsville, Pa., important coal-mining and shipping city on Schuylkill River 75 mi, n.w. of Philadelphia; pop. 24,530; iron and steel products, silk, knit goods, machinery; rail-road shops: map P-112

Poughkeepsie (pō-kip'si), N. Y., port on Hudson River 70 mi. above New York City; pop. 40,478; cream separators, ball bearings, machine parts, cough drops; base for Conthental armies during Revolutionary War; Federal Constitution ratified here (1788); several preparatory schools: map N-114

Mid-Hudson Bridge, table B-342 Vassar College, picture N-119 Poulard (pg-lärd') wheat, picture

woulene (pg-län'), Francis (born 1899), French composer, one of "The Six"; produced work of grace and originality in modern style, including ballet ('Les Biches'). Poulenc chamber music, songs.

6

Poulsen (pôl'sen), Valdemar (1869-1942), Danish electrical engineer and inventor; co-inventor of a wireless telephone system; invented telegraphone, for recording tele-phone conversations, and discovered Poulsen arcs and waves.

Poultry P-336-9 breeding and incubation P-337-8 chickens P-338-9, E-342, pictures P-337: length of life, average. pictograph A-198 duck D-118

gs P-336-9, E-192: production P-386-7; electric lights increase production A-51 goose G-119-20

guinea fowl G-183-4 importance of industry P-336 picking a good hen, picture P-338 production: United States P-338 turkeys T-158

Poultry-mites S-258 Pound, Erra Loomis (born 1885), American poet and critic, born Hailey, Idaho; lived in London after 1907; used new verse forms; translated Chinese and Japanese poetry (poems—'Personae'; 'Cathay'; 'Exultations'; 'Cantos'; prose—'Indiscretions'; 'ABC of Reading') leader of imagist movement A-182

Pound, Roscoe (born 1870), American lawyer and educator, born Lincoln, Neb.; commissioner of appeals, supreme court of Nebraska 1901-3; professor of law, University of Nebraska, Northwestern University, University of Chicago; dean, law school, Harvard University 1916-36.

Pound, a unit of weight W-66-7 affected by gravity P-192 origin W-66-7

Poundal, in physics, British unit of force, equaling the force which imparts a velocity of one foot a second to a mass of one pound; equals 13.825 dynes.

Pound sterling, the monetary unit of Great Britain; par value, fixed in 1870 at 113.001 grains of fine gold; gold par value in United States money \$8.2897, but after Great Britain left gold standard in 1981, exchange value has been about \$4.86; designated by sign (£); originally the term meant an actual silver pound from which 20 shillings were coined; the gold sovereign worth one pound is no longer issued.

Pourquoi story, a medieval fable Manciple's tale in 'Canterbury Tales fable C-162

Poussin (pg-săh'), Nicolas (1594— 1665), French painter; introduced classical style into French art; lived most of life in Rome and was strongly influenced by study of Raphael and antique sculptures; painted historical and mythological subjects and landscapes ('Orpheus and Eurydice'; 'The Shepherds of Arcadia'); P-21

love for Rome E-832

Pouter pigeons P-216, picture P-217 Poutrincourt, Jean de Blencourt de.

See in Index Biencourt de Poutrin-court, Jean de Poverty. See also in Index Relief measures; Slums; Social service hinders democracy D-48 Poverty.

poor relief P-302-3 study of S-184

Powder. See in Index various powders by name

Vincent' (1849-Powderly, Terence Vincent' (1849-1924), American labor leader, born Carbondale, Pa.; general master-workman of the Knights of Labor 1879-93.

Powder River, in n.e. Wyoming and Montana; flows 400 mi. to the Yellowstone: maps M-243, W-194

panelt, John (born 1882), American planist and composer, born Rich-mond, Va.; studied with Leschetiz-ky; uses Negro themes ('Negro Rhapsody'): M-316 Powell, John Wesley (1884-1902),

American ethnologist and geologist Grand Canyon exploration G-131

Powell, Maud (Mrs. H. Godfrey Tur-ner) (1868-1920), American vio-linist, born Peru, Ill.; first American woman to achieve a high reputation as a violinist.

Power, in industry and physics, capacity for doing work at a given rate of speed, P-339-40, P-191, Outline I-77. See also in Index Energy; Force; Industrial Revolution; Machine Age; Machinery; and Poynings, Sir Edward (1459-1521),

chief topics listed below by name atom explosions A-362 compressed air A-62, 64 electric E-235-8, E-215-18 friction, effects F-204, P-193 fuels F-215-17, P-339 hydraulic W-49-52, P-339 hydroelectric W-49-52, pictograph W-50

industry, electrical E-235-8 life transformed through machinery M-10, C-247, pictograph A-50. See also in Index Industrial Revolution

man power versus the machine, pictures I-74i, l, pictograph A-50 echanical applications M-103-6,

mechanical ap picture P-193 model plant, picture V-314

new sources P-339-40: tides T-92; volcanoes V-334 pneumatic P-264-5

production in U. S.: coal C-288; electric E-235, W-49-51; oil C-288 steam S-280-4, T-156 tides T-92

transmission, from hydroc plants E-235, 237, W-51 units in physics P-196, E-224 hydroelectric

volcanoes V-334

water power W-49-52, pictograph W-50 wind W-111

Power, in mathematics P-340-1 exponents: in algebra A-123; used to simplify large numbers S-242, example, table R-14

Power Age, or Second Industrial Revolution 1-741-n Power Commission, Federal U-231

Power of attorney, a statement au-thorizing another person to act for the person granting it in legal or business matters; called "general" when authority is not limited, "special" when for specific act.

Powers, Hiram (1805-73), American sculptor, born Woodstock, Vt.; lived in Florence, Italy, after 1837: S-62

Powers, the Great, a self-constituted group of most important nations which have dominated world since 1815; originally Prussia (now Germany), Russia, Austria, Great Britain and France; Italy was added in 1886; Japan and the U. S. in 1907; Austria and Russia were dropped after 1st World War.

Powers and roots, a branch of mathematics P-340-1

logarithms P-340-1. See also in Index Logarithms

Powhatan (pou-hä-tăn') (1547?-1618), chief of Powhatan Indian confederacy in Virginia at time of first English settlement; father of Pocahontas

captures Capt. John Smith S-165 Powhatan, tribe of Indians of Algonquian family; lived chiefly in tide-water section of Virginia I-53

Powys (po'is), John Cowper (born 1872), English writer and lecturer, elder brother of Llewelyn; forceful and penetrating in his criticism of literature and of life ("Wolfsbane", 'Mandragora', 'Samphire', poetry; Visions and Revisions, The Meaning of Culture, criticism; Wolf Solent, psychological novel; 'Owen Glendower, historical novel).

Powys, Llewelyn (1884-1989), English writer, who for sake of health be-came manager of stock farm in British East Africa; returned to

English statesman; governor Calais 1493; lord deputy of Ireland 1494; assembled parliament of Drogheda, December 1494, at which Poynings' Law was passed making all laws enacted in England equally forceful in Ireland (repealed 1782); given important military and dip-lomatic posts by Henry VII and Henry VIII.

Poynter (poin'ter), Sir Edward John (1836-1919), English portrait and historical painter, director of historical painter, director of National Gallery, London 1894– 1904; designs for Houses of Parlia-ment, St. Paul's Cathedral 'Atalanta's Race', picture A-351

Poynting, John Henry (1852–1914), English scientist; professor of physics, University of Birmingham; author of 'The Earth, Its Shape, Size, Weight, and Spin' and (with J. J. Thomson) "Textbook of Physics'.

Poyser (poy'zēr), Mrs., in George Eliot's 'Adam Bede', farmer's capa-ble wife, noted for her ready wit Mrs., in George E-252

Poznan (pōz'nün), Poland, also Posen, city and railroad center, 170 mi. w. of Warsaw on Warthe River; pop. 248,000; important medieval trade center; held by Prussia 1793-1918 and heavily fortified; distilling and milling industries; annual fair: milling ind

Poznan, also Posen, province in Poland; 11,186 sq. mi.; capital Poz-nan; formerly belonged to Prussia; ceded to Poland after 1st World War; seized by Germany 1939.

P-P (nicotinic acid) V-311a, 312 Prado National Museum, Madrid M-24, pictures M-23, table M-392 'Immaculate Conception' M-304, pic-Madrid ture M-303

Practorian (prő-tő'ri-án) Guard, in Roman history, imperial body-guard, founded by Augustus, sup-pressed by Constantine; frequently made and unmade emperors.

raetorius (*prā-tō'rē-us*), Michael (1571—1621), German composer and Praetorius author; famous for Protestant church music; books are sources on music and instruments of his time ('Syntagma Musicum').

Prae'tors, judges of ancient Rome; held larger powers in emergencies plebeians admitted to office R-131-2

Pragmat'le Sanction, a term applied to several imperial decrees of fun-damental importance, especially damental importance, especial that of Charles VI (1718): M-63 Prag'matism, in philosophy P-173

Prague (prāj) or prāj) (German Prag; Czech Praha), cap. of Ger-man protectorate of Bohemia and Moravia; pop. 850,000: P-341-2, maps G-66, C-422 battle of (1757) S-84

famous clock, picture W-39

Prague, Peace of (1866), between Prussia and Austria; increased Prussian territory.

Prague, University of P-342, U-260 Prahran (prä-răn'), city in Victoria, Australia, suburb 4 mi. s.e. of Melbourne; pop. 52,000.

Prain (prvö), capital of Cape Verde Islands; pop. 6000; cable station and meteorological observatory: C-81

Prairie (prā'rī) P-200, C-270b Africa A-36 Hungarian puzta H-360

Russian steppes A-330, R-180 South America P-200, map S-204: Ilanos S-208k, V-274, map S-208d;

S-208h. A-278-9. mans S-208d, A-279, picture A-280

United States, map S-191c: corn belt may D-113d; trails to the Far West F-13-17; western plains and cattle ranches C-107-15

Prairie chicken, or pinnated grouse

Prairie-dog P-342 rattlesnake and R-52

Prairie du Chien (du shēn), city in Wisconsin, 60 mi. s. of LaCrosse on Mississippi River; pop. 4622; cen-ter of agricultural region; founded 1783, until about 1830 an important military post: map W-124

Prairie Grove, Ark., town 40 mi. n. of Fort Smith; pop. 887; scene of victory of Union troops over Confederates Dec. 7, 1862, which checked further Confederate advance into Missouri.

Prairie hare H-222

Prairie mallow, See in Index Sidalcea

Prairie pocket gopher G-120-1 Prairie provinces, Canada C-50 occupations, pictograph C-50a Prairie rose R-156, pictures N-29a,

R-157

Prairle schooner, or covered wagon F-16, T-124, P-221g-h, pictures C-32, C-61, F-13, P-221h, U-187

Prairie State, or Sucker State, popular names applied to Illinois.

Prairie View State College, at Prairie View, Tex.; founded 1876; for Negroes; arts and sciences, agriculture, home economics, mechanic arts, nursing, graduate school.

Prairie wolf, coyote, or brush wolf W-128, picture W-129 'Praise of Folly', satire by Erasmus

Holbein illustrates H-318

Prajadhipok (prá-chä'ti-pok) 1941), king of Thailand (Siam) (1925–85) T-73b

Prase, a dull-green, translucent quartz used anciently for engravings: found in Saxony.

Praseodymium (prā-sē-ō-dim'i-um), a metallic element of the "rare earth" group found associated with similar element neodymium: table C-168

Prater (prä'ter), park in Vienna V-297-8

Pratt, Bela L. (1867-1917), American sculptor, pupil of Saint-Gaudens and Chapu; statues of John Winthrop, Phillips Brooks, Nathan Hale (Yale campus); figures for main entrance of Library of Congress; work shows exquisite modeling.

Pratt, Edwin John (born 1883), Canadian poet ("Titans"; "Verses of the Sea"). throp, Phillips Brooks, Nathan Hale

Pratt Institute, at Brooklyn, professional school; founded 1887 by Charles Pratt (1830-91), wealthy oil man; fine and applied arts, science and technology, library science: L-106f

a shrimp-like crustacean Prawn. S-135

Praxiteles (praks-it'e-lez) (4th century B.C.), Greek sculptor, greatest of his age G-166 statue of Hermes G-166, 168, S-53, picture S-55

Prayer, Book of Common, the name given to the official service book used in public worship in the Church of England, and the Episco-

pal Church in the United States. Prayer rug R-171, color plate R-171a-b Prayer wheel, a wheel or cylinder, used by Lama Buddhists, containing the prayer "O Lotus jewel, amen!" written on many sheets of paper. Revolving the wheel is believed he effective as reciting ลร prayers.

'Praying Hands', drawing by Dürer, picture D-100

Praying mantis, an insect M-55, picture M-55

Preacher-bird, or red-eyed vireo V-303, color plate B-139

color plate B-139

"Preacher Smith" (1828-76), popular name of Henry Weston Smith, ploneer Methodist preacher, born Ellington, Conn.; served in Civil War 1861; practised medicine (homeopathy) after 1867; settled near Deadwood, S. D., in 1876, preaching among miners; killed by Indians.

Preb'le, Edward (1761-1807), American navel officer; commanded expenses

ican naval officer; commanded expedition against Tripoli (1803-05) flagship Constitution, picture N-566 Precedence

British titles of nobility D-34 U. S., official Washington D-34

Precession, principle of G-191, pic-tures G-191, 192 equinoxes S-275: gyroscopic prin-ciple G-191; sun and moon cause

E-133-5, picture E-134

Precious coral C-364

Precious metals, term usually re-stricted to gold and silver; also includes platinum and mercury. in Index names of those metals allovs A-132-3

Precious stones G-25-9. See also in Index Gems

Precipitation, in chemistry C-174 W-60. Precipitation, in meteorology W-60, W-42a, See also in Index Rainfall, and other subjects listed below clouds C-281

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water cycle W-42a

Predatory animals, in balance of nature B-145

Pred'icate, in grammar sentence S-78, S-79 verb V-281

Preemption, in public land settle-ment, right of purchasing before others L-60

Preface, or foreword, of a book B-181 Prefect, French official F-179

Preferential shop, in labor L-44c Preferred stock S-290, 291

Prefixes, in English E-282 Prehistoric Age, Outline A-192. See also in Index Archeology; Civilization; Man

archeological research A-249-54: American A-147-9 early races of man M-45-9, S-292-3

migrations of peoples M-168 Prehistoric animals A-204-10. See also

in Index Animals, prehistoric Prehistoric man M-45-9. See also in Index Man

Prehistoric relies. See in Index Archeology; Man

Prelude, in music, an introduction to prepare for succeeding parts of a composition; also independent pieces of informal character.

'Prelude, The', poem by Wordsworth W-146

Premier, or prime minister Canada C-63 England C-3: residence L-188 France F-179

Italy I-158, 159, M-325 Pre'mium, in insurance I-94, 95, 96 Premo'lars, or bicuspids T-28, pictures

Premonstratensians, or White Canons a religious order of the Roman Catholic church M-233

Prendergast, Maurice Brazil (1861-1924), American painter, born Boston, Mass.; imaginative, decorative, and colorful landscapes with figures ('Sunset and Sea Fog'; 'The Fête').

Prendergast, Mehitable Wing (1737-1811), born Dutchess County, N.Y.; heroine of "anti-rent" trial held at Poughkeepsie, N.Y., 1766 at which her husband, William Prendergast (1727-1811), was condemned to be hanged for leading a revolt against proprietors of land. She went at once on horseback to New York City and obtained a reprieve from the governor and was back in three days. She also applied to King George III and obtained a full par don in six months.

Preparedness, military, in U. S. 1st World War W-168 2d World War. See Defense program

Preposition, in grammar P-342-3

Pre-Raph'aclites, group of painters and poets of 19th century P-22-3,

example of work, picture P-23 Millais M-174 Morris M-261 poetry E-287

Rossetti R-158-9 Presbyopia (pres-bi-ō'pi-a), eye de-fect E-352

Presbyte'rian College, at Pine Tree Hill, near Hallfax, Nova Scotia; men; established 1820; theology; affiliated with Dalhousie Univer-

Presbyterians, a Christian denomination; named from system of church government by presbyters, or elders; doctrines generally Calvinistic; world membership 45,000,000 America C-233

American colonies A-161, P-369/ Canada, unite C-234
Calvin's influence C-35
Knox in Scotland K-37, S-46 numerical rank R-72 origin C-233, P-369 Wales W-3

Presbyters, or elders, in early Christian church C-232

Prescott, William (1726-95), American soldier, organized regiment of minutemen (1774) at Breed's Hill B-271

Prescott, William H. (1796-1859) American historian; achieved great results in face of invalidism and partial blindness: A-179

Prescott, Ariz., industrial and com-mercial center; pop. 6018; about 85 mi. n. of Phoenix; 5347 ft. above sea level; copper, gold, silver min-ing; stock raising: map A-289

Presenio (prā-sā'pē-ō), manger scene in Italian Christmas celebration C-227, C-2290

Preservatives, for foodstuffs A-223 formaldehyde injurious F-160 salt S-15

President, of France F-179

President, of the United States P-343-4. A list of the Presidents of the United States will be found in the table on the next page cabinet C-3

Congress and C-332, U-220 election P-343-4

contested elections: of Adams A-15, J-178; of Hayes H-250; of Jefferson U-210

electoral vote P-343, tables P-344, TT-380

THE PRESIDENTS OF THE UNITED STATES

Name	TERM	Age	PARTY	ELECTED FROM	OCCUPATION
George Washington	1789-1797	57	Federalist	Virginia	Planter
John Adams	1797-1801	61	Federalist	Massachusetts	Lawyer
Thomas Jefferson	1801-1809	57	Democratic-Republican	Virginia	Planter
James Madison	1809-1817	57	Democratic-Republican	Virginia	Public officia
James Monroe	1817-1825	58	Democratic-Republican	Virginia	Lawyer
John Quincy Adams	1825-1829	57	Democratic-Republican	Massachusetts	Lawyer
Andrew Jackson	1829-1837	61	Democrat	Tennessee	Lawyer
Martin Van Buren	1837-1841	54	Democrat	New York	Luwyer
William Henry Harrison (died one month after inauguration)	1841-1841	68	Whig	Ohio	Farmer
John Tyler (became president at			TTYL	********	Y
death of Harrison)	1841-1845	51	Whig	Virginia	Lawyer
James Knox Polk	1845-1849	49	Democrat	Tennessee	Lawyer
Zachary Taylor (died 16 months after inauguration)	1849-1850	64	Whig	Louisiana	Soldier
Aillard Fillmore (became president at death of Taylor)	1850-1853	50	Whig	New York	Lawyer
Franklin Pierce	1853-1857	48	Democrat	New Hampshire	Lawyer
ames Buchanan	1857-1861	65	Democrat	Pennsylvania	Lawyer
braham Lincoln (assassinated one	1001 1001	U.O	Democrati	1 Ching I vibilia	2.7011 3 01
month after second inauguration)	1861-1865	52	Republican	Illinois	Lawyer
ndrew Johnson (became president at death of Lincoln)	1865-1869	56	Republican†	Tennessee	Tailor
llysses Simpson Grant	1869-1877	46	Republican	Illinois	Soldier
Sutherford Birchard Hayes	1877-1881	54	Republican	Ohio	Lawyer
ames Abram Garfield (died from					
inauguration)	18811881	49	Republican	Ohio	Lawyer
hester Alan Arthur (became presi-					
dent at death of Garfield)	1881-1885	50	Republican	New York	Lawyer
Frover Cleveland	1885-1889	47	Democrat	New York	Lawyer
enjamin Harrison	1889-1893	55	Republican	Indiana	Lawyer
rover Cleveland (second term)	1893-1897	55	Democrat	New York	Lawyer
Villiam McKinley (died from assas- sin's bullet six months after second					
inauguration)	1897-1901	54	Republican	Ohio	Lawyer
dent at death of McKinley; re- elected 1904)	1901-1909	42	Republican	New York	Public officia
Villiam Howard Taft	1909-1913	51	Republican	Ohio	Lawyer
oodrow Wilson	1913-1921	56	Democrat	New Jersey	Educator
arren Camaliel Harding (died 29 months after inauguration)	1921-1923	56	Republican	Ohio	Editor
alvin Coolidge (became president at	***** TOPU		rechunican	Onto	THE PARTY OF THE P
death of Harding)	1923-1929	51	Republican	Massachusetts	Lawyer
lerbert Hoover	1929-1933	54	Republican	California	Engineer

*In 1849, March 4 fell on Sunday and Taylor did not take the oath of office until the following day. It is popularly believed, therefore, that David R. Atchison, president of the Senate, was acting president of the U.S. for a day—from noon March 4 to noon March 5, but this belief has never been supported by competent legal authority.

†Johnson had been elected vice-president on the Republican ticket, but was himself a Democrat.

original method U-214: changed by 12th amendment U-210, (text) U-217 Executive Office U-232, chart U-229 expenses W-88 flag and colors F-91, color plate F-87 inauguration P-344: 20th amend-ment U-218 Military Academy, appointments to M-171 Naval Academy, appointments to N-45 office, picture U-221 qualifications and powers U-215, removal or impeachment P-344 salary P-344

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veto power V-292: Constitution, text U-213

White House Office U-232 wives of the presidents W-89-94 President', an American frigate

Presidential elections. For statistics of presidential elections see table

on page U-380 Presidential electors, in United States

P-343-4 Presidential Succession Act (1886)

U-221 Presidential system of government D-48

Presid'ie (Spanish "fort"), U. S. Army post at San Francisco, Calif., on s. border of harbor; Spanish military post 1776, then Mexican fort until 1848.

Presidio, garrison town in Southwest S-223, C-32, 33

Millcreek township, Erie County, Pa. P-115 Perry at P-126

Press, a device operated by pressure

bookbinding B-186 hydraulic H-368, picture H-367 machine tool T-110, pictures T-109, O-221

pneumatic P-265 printing P-347-8, pictures B-185, 191

stamping T-110, picture T-109 Press, freedom of P-348. See also in Index Freedom of the press

Press agent, publicity adviser A-24b Pressburg, Germany. See in Index

Bratislava

Pressburg, treaty of (1805), peace between France and Austria after the latter had been defeated for the third time by Napoleon; large cessions to France.

Pressing garments S-92

Presque Isle (presk el), a part of Press release, source of news N-109

Pressure, the force exerted on unit area atmospheric A-62, 64: in siphon

S-153; measuring B-49-50 boiling point, effect on W-44 critical, of a gas G-18 "electric pressure" E-221, 223 freezing point, effect on F-194

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osmotic P-239-40, pictures P-237 sap in plants P-240

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water, in ocean depths O-196, O-198: divers D-72

Pressure cooker W-44 canning C-74, 75

Pressure gauge, of airplane engine A-76

Pressure groups, in politics, general name for groups, committees, or associations which through mass meetings, letters, telegrams, publicity, or other propaganda devices attempt to influence government agencies in behalf of some special policies or interests. See also in Index Bloc; Lobbying

Pressure turbines T-156

Prester John, king and priest of a mythical land which had no poor, no thieves, no lies, no vices; legends of 12th and 13th centuries Ethiopia, supposed kingdom E-309 flag F-97-8, color plate F-88

Presto, in music, rapidly; 184-208 metronome beats to the minute.

Preston, Andrew W. (1846–1924), American merchant, founder of banana industry B-36

Preston, England, port 28 mi. n.e. of Liverpool at mouth of Ribble River; pop. 119,000; cotton manufacturing center; also manufactures brass and iron products, ships, beer; exports coal: map E-270a

Preston, Ontario, Canada, town at junction of Speed and Grand rivers, 28 mi. n.w. of Hamilton, in fertile agricultural and dairy community; noted for mineral springs; stoves and furnaces, furniture, shoes; pop. 6280: map. inset C-50b

Prestonpans', Scotland, village on Firth of Forth; victory of Jacobites under Prince Charles Edward over royal army Sept. 21, 1745.

Prestwich, Sir Joseph, English geologist M-45

Pretender, name applied to son and grandson of James II of England, who claimed English and Scottish thrones P-344-5

Preto'ria, capital of Transvaal province and of Union of South Africa, 32 mi. n.e. of Johannesburg; pop. 130,000 (including 77,000 Europeans): may A-42a Boer War B-167, R-117

Pretoria, Treaty of, sometimes called Peace of Vereeniging, ended Boer War (1902) B-167

Prevailing westerles, winds W-112, picture W-113 effect on rainfall R-47

Prevention of disease. See in Index Disease, subhead prevention

Prevost, Sir George (1767-1816), English soldier, born New York, N.Y.; appointed lieutenant governor of Nova Scotia, 1808; in 1811 made governor in chief of British North America; defeated at Plattsburg in 1814 (War of 1812).

Prévost d'Exiles (prā-vō'dēg-zēl'), Antoine François (Abbé Prévost) (1697-1763), French novelist; a Benedictine monk, fled to England and Holland because of disobedience, but was received back into order; famous for his romantic love-story 'Manon Lescaut'.

Priam (prVam), in Greek mythology, king of Troy T-143, 144 recovers Hector's body H-269, picture A-8

Priagus (prī-ā'pūs), in Greek and Roman mythology god of fertility and reproduction; considered luckbringer by hunters and fishermen.

Pribilof (prē-bi-lōf') Islands, Alaska, group of five islands in Berlng Sea, abounding in fur seals; chief islands St. Paul (35 sq. mi.) and St. George (27 sq. mi.); pop. about 500: A-102, map A-105

restrictions on sealing S-69, 70 seal rookery, picture S-69

Price, Byron (born 1891), newspaperman, born Topeka, Ind.; with The Associated Press after 1912; appointed United States Director of Censorship December 1941: N-12n

Price, Sterling (1809-67), American Confederate general, brigadier general in Mexican War; governor of Missouri 1853-57.

Price Administration, Office of (OPA), U. S. U-232, R-146q, N-12e-f, p, 13 price control N-12p

Prices, in economics advertising affects A-23, 24 attempt to regulate rubber R-164-5 boards of trade E-152, B-160-1 control in war N-12n, p-q fixed by trusts T-146, 147 grain, arbitraging B-160-1 grain market E-151-2

index numbers of commodity prices M-221, 222: relation to wages G-136h-j, graph G-136j money and exchange M-221, F-153

net price system B-190-1 Prichard, Katharine S. (born 1884), Australian novelist A-376

Prickly ash, a shrub or small (Zanthoxylum americanum) tree of the rue family, so called because of its prickly leaves; because of the medicinal qualities of the bark, one species is popularly known as the toothache tree.

Prickly lettuce, a compass plant C-327 Prickly pear, a flat-stemmed cactus and its pear-shaped fruit C-10, 11 Burbank's thornless, picture B-277 menace in Australia A-375

Prickly poppy. See in Index Argemone

Pride, Thomas (died 1658), parliamentary officer in English Civil War; carried out order (1648) to expel by force Royalist and Presbyterian members from House of Commons ("Pride's Purge").

'Pride and Prejudice', novel by Jane Austen (1813); the quiet story of a middle-class English family, the Bennets, including charming Elizabeth Bennet, the heroine; marked by humor and keen observation of people and customs.

Prideaux, Sarah T., English bookbinder ('Historical Sketch of Bookbinding'; 'Aquatint Engraving') B-183

Pridvorov (prēd-vôr'ôf), Yefim Alexeyevich. See in Index Byedny

Prienc (pri-ë'në), ancient Greek city in w. Asia Minor; excavations have revealed a well-planned city, fine examples of Ionic architecture, and inscriptions and ancient objects preserved by volcano A-251 Priestley, John Boynton (born 1894), English writer, born in Yorkshire ('Angel Pavement', 'Good Companions', novels; also author of plays and essays).

Priestley, Joseph (1733-1804), English chemist and non-conformist theologian; discovered oxygen 1774; experiments important in development of chemistry; author of scientific, theological, and philosophical works; forced to leave England (for America) because of religious and political views named rubber R-163

Primary cell, in electricity E-215 Primary colors C-308b, h psychologists' theories C-308j Primary elections P-345, P-293

Pri'mate, of English church, the Archbishop of Canterbury C-76

Primates (pri-ma'téz), the highest order of mammals, including man, apes, monkeys, lemurs, and tarsiers; characterized by hands adapted for grasping, and fingers bearing nails instead of claws: M-231, Outline Z-230

'Primavera' (prē-mä-vā'rā), a painting by Botticelli, pioture P-16 Prime, "canonical hour" M-233, 234

Prime factor, in algebra A-124 Prime minister, or premier

Canada C-63 England C-3: residence L-188 France F-179

Italy I-158, 159, M-325

Prime mover, an original source of power or the machine for generating power from an original source. The principal prime movers are animal muscles, wind, water, and heat engines. See also in Index Gas engine; Power; Steam engine; Turbine; Water wheel; Windmill

Primer, of explosives, substances which explode at a blow and set off the main charge

fulminates E-347-8, F-50 stibnite M-182

Priming coat, first coat of paint P-32b Primitive Area, in Idaho I-9 Primitive man M-45-9. See also in In-

Primitive man M-45-9. See also in Index Man leisure L-93a

Primo de Rivera. See in Index Rivera Primogen'iture, right of eldest son to inheritance feudal times F-28

feudal times F-28 Jefferson abolishes Virginia law J-208

states of U.S. abolish A-317

Primrose, Dr. Charles, clergyman in Goldsmith's 'Vicar of Wakefield' G-115, 116

Primrose, a flowering plant P-345 how to plant G-11

Primrose, evening, or cenothera N-39 fuchsia related to F-215 how to plant G-11

Primrose family. See in Index Primulaceae

Primrose League, conservative political organization in England; founded in 1883 in memory of Disraell; name taken from his favorite flower; both men and women members: D-71

Primula (prim'yū-lā), the primrose genus P-345 how to plant garden varieties G-11

how to plant garden varieties G-11 Primulaceae (prim-yū-lū'sē-ē), the primrose family, a large group of herbs containing more than 25 genera and about 400 species of world-wide distribution but most abundant in temperate regions of the northern hemisphere; common

members of the family are primrose, loosestrife, water pimpernel, American cowslip or shooting star, water violet, and cyclamen.

Pri'mus, a hybrid berry R-51

Prince, a title of power or rank, first applied to certain Roman senators; in Europe a male descendant of a royal house; in England almost entirely confined to royal family.

Prince, hy 'rince, The', political treatise by Machiavelli. See in Index Machia-

velli, Niccolo

Prince Albert, Saskatchewan, Canada, distributing city for farming region on n. Saskatchewan River 82 mi. n. of Saskatoon; pop. 11,049; lumber, live stock, and fur interests; packing houses, government stockyards: map C-50b

Prince Albert fir. See in Index

Western hemlock

Prince Albert National Park, Sas-katchewan, Canada N-23

Prince and the Pauper, The', book by Mark Twain, which relates the imaginary adventures of a beggar boy and the Prince of Wales (later Edward VI), who resemble each other exactly and who change places temporarily.

Prince consort, term for husband of a reigning queen; specifically Albert, husband of Queen Victoria. See in Index Albert, prince of Saxe-

Coburg-Gotha

Prince Edward Island, the smallest of the Canadlan provinces, in Gulf of St. Lawrence; 2184 sq. ml.; pop. 88,088; cap. Charlottetown: P-345, map C-50c

libraries L-106n

Prince Edward Island National Park, a Canadian park extending 25 mi. along the north shore of Prince Edward Island, offering seashore recreation; established 1936; area 7 sq. mi.

"Prince of Humbug" (Barnum) B-49 'Prince of India', novel by Lew Wal-lace W-7

Prince of Wales, title of heir to Brit-

ish throne W-3
Prince of Wales, Cape, Alaska,
westernmost point North American
mainland, on Bering Strait, map A-105

Prince of Wales, Edward. See in Index Edward, Prince of Wales

Prince of Wales College, at Charlotte-town, Prince Edward Island; pro-vincial control; founded 1860; arts and commerce.

Prince of Wales Island, one of chief islands of Alexander Archipelago, Alaska, map N-150b Old Kasaan National Monument

Old Ka N-22c

Prince of Wales Island, Canadian island in Arctic Ocean, map C-50b

Prince Patrick Island, uninhabited Canadian island of Arctic region, map N-150b

Princeps, title assumed by Augustus A-364

Prince Rupert, British Columbia, seaport and railroad terminus on Pacific coast on an island about 35 ml. s. of Alaska boundary; pop. 6850; lumbering fishing, and mining interests; large dry dock: map C-50b

Princes in the Tower, Edward V and his brother E-190

"Princess Pat." See in Index Ramsay, Lady Patricia

Princess Ragnhild Land, Antarctica P-286, map A-215

Princes Street, Edinburgh E-156, pioture E-158

Princeton, N. J., borough 44 mi. s.w. of New York City; pop. 7719; first state legislature of N. J. met here Aug. 27, 1776; battle of Princeton; victory of Washington over British under Cornwallis Jan. 3, 1777; Continental Congress 1783; Princeton University; Institute for Advanced Study; Princeton Theological Sem-

Princeton University, at Princeton, N. J.; for men; originally Presbyterian, now non-sectarian; char-tered as College of New Jersey 1746; opened at Elizabeth 1747; removed to Newark 1748, to Prince-ton 1754; arts and science, architecture, civil, electrical, mechanical, mining, and chemical engineering; school of public and international affairs; preceptorial plan of instruction; graduate school Chancellor Green Library, picture

Cleveland at C-267-8 football, first intercollegiate game F-151a-b

Procter Hall, picture E-180 Wilson at W-106

Princip, Gavrilo, assassin of Archduke Francis Ferdinand, June 28, 1914 W-149

Principal, money upon which interest is paid P-120

Principe (pröh'sö-pā) Island, small Portuguese island in Bight of Biafra w. of Africa; forms province with island of São Thomé (St. Thomas); area of province, 384 sq. mi.; pop. 60,000: map A-42a

'Principia', treatise by Newton N-112, M-106

Principla College, The, at Elsah, Ill.; Christian Science founded 1932; arts and sciences.

Principii (prin-sip'i-i), in Roman Legion A-307f

Principle of Archimedes P-193

Pring, Martin (1580?-1626), English explorer, "last of the Elizabethan seamen"; commander of two ships which sighted Penobscot Bay (1603) and Casco Bay and landed at Plymouth; explored coast of Virginia (1606).

Printing P-346-8. See also in Index

Books and bookmaking; Printing press; Type; Typography beginnings P-346--7, B-180-1: American L-67b, A-176, C-36; Chinese P-346; Korean K-38 block books P-346, B-180

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color-printing E-298, C-308h, j, color plate C-308i; early P-347; Japanese J-202, color plates J-196a-b, 202a-b; newspaper and magazine P-348

communication extended by C-324 education influenced by B-164 electrotype E-243, picture B-184 engraving and etching B-293-8 first printed book P-346-7, picture B-179

forms on the press B-184-5 inks I-80

invention and spread of T-173-4, P-346-7

leisure influenced by L-93a lithography L-164, I newspapers N-104-9 E-293-4, 298 paper P-56-61 photographs P-183-4 stereotyping S-287 typography and printing types T-172-4

Printing press P-347-8 flat bed P-347-8, pictures B-185

Gutenberg's, picture B-191 rotary P-348, picture P-347 stereotyping S-287 web P-348

Prints, textiles development T-65-6 English T-68, picture T-67 French T-66, picture T-68 process of printing T-71

Printz, John (1600?-63) Swedish colonial governor and soldier; founded early settlement in Pennsoldier: sylvania: P-116

Prior, Matthew (1664-1721), English poet and diplomat, best remem-bered for his light humorous verse. Prior, monastic officer M-234

Prioress's Tale, in 'Canterbury Tales'

Priorities, system of, in 2d World War

United States N-12f, R-146p

Priory, a monastic house presided over by a prior or prioress.

Pripet (pre'pet), river in w. Russia. rises in group of lakes and marshes in e. Poland; flows e. and s.e. 400 mi, to Dnieper.

Prish'tina, or Priš'tina, Serbia, Yugoslavia; pop. 14,000; under Turkish rule before 1912: map B-18

Prism, optical instrument colors C-308b, picture C-308a diffracts light S-241, 242, picture S-243 field glass T-39

periscope P-126

refracts light L-126-7, diagram L-127 telescope T-38

Prismoid, a body resembling a prism volume of M-117 analyzing

Prism spectroscope, for light S-242, picture S-243

Prison, or penitentiary P-348-50 Mexico City, picture P-349 Tower of London L-183-4, picture L-190

United States federal U-223

Prisoner of Chillon, The', poem by Byron about François de Bonni-vard, 16th-century French monk and republican enthusiast im-prisoned by Duke of Savoy.

Prisoner of Zenda, The', a romantic story by Anthony Hope (Hawkins) of adventures of an Englishman in imaginary Balkan kingdom.

"Prisoner's Base," game P-249 Prisoners of war I-109

Prison reform P-349-50 Hayes works for H-253

Prisrend (prez'rend), Yugoslavia. See in Index Prizren

Pritchett, Henry Smith (1857-1939), American educator, born Fayette, Mo.; professor astronomy Wash-ington University, St. Louis, 1883-97; superintendent U. S. Coast and Geodetic Survey 1897, 1000 Geodetic Survey 1897-1900; president Massachusetts Institute of Technology, 1900-06; president Carnegie Foundation for Advance-ment of Teaching 1906-80.

Private, in U. S. Army, a soldier below non-commissioned officer insignia, picture U-178 rate of pay N-12j

Private banks B-42

Private enterprise, Laissez-faire See in Index

Privateer'ing P-222 Captain Kidd K-15-16

Drake D-90-1 rights under change of sovereighty 1-109

rules of war I-109 Privet, shrub used for hedges H-269 Priv'y council, England C-3 judicial powers C-385; in American colonies A-160; in Canada C-64

Privy seal, the minor seal of Great Britain, not used after 1884; keeper called Lord Privy Seal, still a member of the cabinet, without specific duties.

Prix seam, or saddlers' seam G-107 Prize court I-110

Prize fighting. See in Index Boxing Prizes, of war

international law I-110

Prizren (prēz'rēn), Yugoslavia, for-merly Prisrend, Serbian town 40 mi. n.w. of Uskup; pop. 16,000; nu-merous mosques; once Turkish city; taken by Serbs in Balkan Wars, by Bulgarians in 1st World War; many bazaars, active trade: map B-18

Proa (pro'a), a Malaysian vessel B-166

Probability curve, in measurements and tests I-72, diagram I-71

Probable error, in biometry B-118 Pro'bate, in law, the proceeding by which a will is formally proved, or shown to be authentic and yalid; usually conducted in a special probate court: W-98

Probation, in juvenile courts J-232 Problem-project method, in education E-184

Proboscidea (pro-bo-sid'e-a), an order of hoofed animals having a proboscis, as the elephant Z-229

Proboscis (prō-bōs'is), a snout, trunk, or other tubular organ projecting from the head of animals bee, picture B-73

butterfly, picture B-285 elephant E-245 sea elephant S-70 tapir T-10, picture T-12

Proboscis-flower. See Unicorn-plant Proboseis monkey M-230, picture

M-220Procaine, a local anesthetic, substitute

for cocaine B-111 Procedure, rules of, in clubs and so-cieties, the rules by which meetings

are conducted P-79-81 Procellariiformes (prō-sē-lār-i-fōr'-mēz), an order of sea birds, comprising albatrosses, shearwaters, fulmars, petrels.

Process, in anatomy a slender projecting bony outgrowth or point

S-155

Processed cheese C-164 Proclamation of 1763, British R-82, TI-234

Procee (prok'nē), sister of Philomel. See in Index Philomel

Procon'suls, provincial governors of

ancient Rome R-134

ancient Rome R-184
Proco'pius (490?-562?), Byzantine
historian; secretary to Belisarius
on his campaigns; his history (in
Greek) of the wars against Persians, Vandals, and Ostrogoths is
the standard authority; wrote book
on Emperor Justinian's buildings, also memoirs exposing life at court.

also memoirs exposing lite at court.
Procrustes (pro-kriz*tēž) ("the
stretcher"), in Greek legend, robber
who placed guests on a bed and
stretched short men and chopped
off tall ones to fit (proverbial "bed
of Procrustes"); slain by Theseus.
Procter, Adelaide Anne (1825-64),
English poet, daughter of Bryan
Waller Procter ('A Lost Chord').
Bryan Bryan Waller (Barry Corn-

Procter, Bryan Waller (Barry Cornwall) (1787-1874), English poet; friend of Lamb, Keats, Scott, Dickens, Tennyson; known for simple

and melodious lyrics ('Dramatic Scenes and Other Poems'; 'English Songs'; 'Charles Lamb', a memoir).

roctor, Alexander Phimister (born 1862), American sculptor, born On-tario, Canada; best known for wild animals and equestrian statues and annuals and equestrian statues and groups; works show direct handling, power, and honesty ('Tigers', at Princeton University; 'The Pioneer Mother'; Roosevelt as rough rider).

Proctor, Richard Anthony (1837-1888), English writer of popular books on astronomy; lived in U. S. after 1881; his daughter, Mary Proctor, wrote books on astronomy for children.

Procyon (prō'sī-ŏn), a star S-274, charts S-275, 275f, h

Prodigal Son, in a New Testament parable (Luke xv, 11–32) the younger of two sons who demanded his heritage and spent it in rictous living; when his wealth was gone and he returned to his father's house truly repentant, a joyful feast was held in his honor.

Produce exchange, or board of trade B-160-1

grain exchange E-151-2 records of U-230

Producer gas G-23

Producers' cooperatives C-355a

Production, in economics E-146-7. Sec also in Index By-products; Machine age; Mass production

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Industrial Revolution I-74-74o: increase per man-hour, pictograph I-74n; iron and cotton industries, pictographs I-74e, k
limitation: agriculture R-146f,

mathographs agriculture R-1467, A-569-57; coffee B-226d; petroleum C-342; rubber R-164-5 machine methods E-150-1, M-10, I-74-740, I-93a-b: 2d World War

organization I-74a-d specialization E-151, I-110-110a Production Credit Associations F-12 Production Management, Office (OPM) R-1460

rofessional schools E-181-2, 183-4, U-257–8, C-302 Colonial America E-181 degrees U-257

Professor, rank in teaching U-258 Profile, of soil S-191b, pictures S-191, 1915

Profile Mountain, N. H. N-85

Profit, in economics, the net return from the employment of capital motive in production E-148-50 stockholders S-290

Profit sharing, in industry L-44b 'Progress and Poverty', book by Henry George T-18

Progressive party, or "Bull Moose" party, U. S. P-293, T-3 Roosevelt leads R-152

Prohibition P-350-1. See also in Index Liquor laws established in U.S. as national con-

established in U. S. as national con-stitutional law P-350-1, U-211: 18th amendment, text U-218 repealed in U. S. P-350-1, R-1461: 21st amendment, text U-218 temperance T-44, W-99 Woman's Christian Temperance

Woman's Chr Union W-131

Prohibition party, U. S. P-350
Projectile (prō-jēk'til), a missile. See
also in Index Bullet; Torpedo artillery A-320-1 bomb, aerial A-307, picture A-740 cartridges F-50-2

defense against, naval N-54-5 electric projector, picture A-307b explosives E-348 Galileo discovers parabolic path of

G-2 gas shells G-24-5 harpoon W-80, picture W-78 lead L-76

rockets F-60, 62, picture F-61 Projection, of maps M-58-9

Projection apparatus, lanterns and lenses for throwing pictures on a lenses for thro screen S-285-6 balopticon S-286

microfilms N-109, L-106p motion picture projector M-280, pic-tures M-279, 285 stereopticon S-285-6

Zeiss, planetarium, picture A-345 Projection drawing, in engineering D-102-3

Projective geometry G-52

Project method, in education E-184 Prokofieff (pro-kôf'yěf), Sergei (born

1891), Russian composer of extremely modern tendencies ('Love of Three Oranges', 'The Gambler' operas; 'Scythian Suite', for orchestra; 'Age of Steel', ballet).

Prokopevsk, industrial city in s. Siberia, s. of Tomsk, in rich coalmining area; iron and steel mills pop. 110,000: map A-332b

Proletariat (pro-le-ta'ri-at), class of society C-324d-25 dictatorship in Russia D-87d

Prometheus (pro-me'thus), in Greek mythology, hero who championed man and defied Zeus P-351

Pandora and P-53, picture P-54 Prometheus Bound', tragedy by Aeschylus P-351

Prominence, solar S-328

Promised Land, of the Jews J-216 Promissory note P-121-2, C-394, B-39 Promotor of the Faith. See in Index "Devil's Advocate"

Pronghorn, antelope A-218, picture A-219

Pronoun P-351-2

Pron'tosil, a drug A-222

Pronu'cleus, in biology, nucleu a gamete, or reproductive H-284, pictures H-285 nucleus of

Pronuncia'tion, correct, in conversa-tion C-347o: alphabets, table A-434 Proof, in geometry G-50

"Proof," in measuring alcohol in beverages A-112

Proof box, in bakery B-230

Propaganda C-324b analysis C-324c Fascist policy F-18 governments and C-324b-c

newspapers and magazines A-24b,

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N-107, M-26 radio R-31a-b

war and C-324b: in 1st World War W-156, 162, 165, 169; in 2d World War W-178e-f

Propaganda, Congregation of, Roman Catholic organization founded by Gregory XV in 1622 to regulate ecclesiastical affairs in missionary countries; headed by a cardinal prefect. Propagation of light L-125, 128

Propane, a compound of hydrogen and carbon. See also in Index Paraffin series

use in gas engines G-19

Propeller, device for propelling by screwlike action in fluids airplane A-67, 83-4: making for model plane A-92, 93-4; speed and pitch control, picture A-84

autogiro A-86 helicopter A-86

invented by Ericcson E-300, S-122 manganese bronze A-137, M-53 ship 5-152-4, 123, picture S-123 torpedo T-114
Propertius (prō-pēr shī-ās), Sextus (507-15 B.C.), greatest Roman ele-

giac poet L-69

Property, in law, anything subject to legal ownership; particularly apanything subject plied to things of economic value beginnings of property rights F-141 civil courts settle disputes C-385 socialist and communist doctrines S-180-1, C-324*d*-25 taxation T-16-18

teaching property rights C-142 wills W-98

(1775?~1834), Shawnee leader, brother of Tecumseh; preached re-turn of his people to primitive ways: T-28 Prophet, The, (1775?-1834),

"Prophet of Italian Unity," Mazzini M-94

Prophets, Hebrew P-352-3

'Prophets, The Frieze of', painting by Sargent S-29, picture P-353

Prophet's Town, Tecumseh's village near Lafayette, Ind. T-28 Propolis (prop'o-lis), or bee glue B-75

Propontis, ancient name for Sea of Marmara map E-326e

Proportion, in mathematics, the equality of ratios between two or more pairs of numbers; for exammore pairs of numbers; for example, $\frac{2}{3} = \frac{6}{9}$, which is also written 2:3 = 6:9; the first and last numbers (2 and 9) are called the "extremes," the other two are the "means," and the product of the means is equal to the product of the extremes: thus $2 \times 9 = 3 \times 6$; useful is solving many problems. useful in solving many problems.

Proportional representation, in city government (Hare system) M-302 Proposition, in geometry G-49

Proprietary government American colonies A-152, 154 Carolinas N-159 Maryland M-78 New Jersey N-93 Pennsylvania P-116

Propylnea (pröp-i-lé'à), monumental gateway to Acropolis A-11, picture G-152

Proscenium (pro-se'ni-um), in theater T-76

Prose, writing of W-185-91

Prose Edda I-5b, S-36 Proserpina (pro-sēr'pi-na). See in Index Persephone

millet, or broomcorn millet M-176

Prospaltel'la, a wasplike parasite controls mulberry scale I-90

Prospecting, for minerals M-186, E-343-4

petroleum P-146, M-186

Pros'pero, in Shakespeare's 'The Tempest', the banished duke of Milan T-44

quoted S-100b

Protagoras (prō-tāg'ō-rās) (480?-411 B.C.), Greek philosopher, first to call himself sophist and to teach for payment; taught that "man is the measure of all things."

Protea (prō'tē-d) family, or Proteaceae (prō-tē-d'sē-ē), a family of plants, shrubs, and trees, native chiefly to Australia and South Africa, including the banksias, Chile hazel, silk-oak, hakeas, silvertree, Queensland (or macadamia) nut, roupalas, and waratah.

Protection and free trade, in economics T-13-13a, b. See also in Index Tariff. England E-273, 276

Protective coloration and resemblance, among animals P-353-6 birds B-131-2, P-354: grouse G-180; quail Q-1; whippoorwill W-84b-5 quail Q-1; whipp cephalopods M-218 chameleon C-137b

crab, picture C-364 fish F-70-1: flatfish F-104; sea dragon, picture S-67; sea-horse S-67 insects I-84, pictures I-85; dead leaf,

insects I-84, pictures I-85: dead leaf, oriental, or Indian leaf butterfly, pictures P-355, I-85 mammals: badger B-13; giraffe G-92; okapi G-92; rabbit H-222; tiger T-93; zebra, picture Z-216 principles applied in camouflage C-39, P-354, pictures W-161 white animals in Lake Otero basin, N. M. N-96

Protective tariff T-13-13a, b. See also in Index Tariff

Protec'torate, in England (1653-59) Cromwell as "Lord Protector" C-401

Protectorate, a term designating the virtually complete control by a strong nation of the foreign and domestic affairs of a weaker nation which has surrendered these powers in return for a guarantee of protection: C-308. See also in protection: C-308. See Index Mandates Proteins (proteins) P-356 albumen A-111

amino acids, chief components of protein molecule B-109, N-148 casein M-173, P-245j, 246 cheese C-164

chemistry B-109-10, N-147-8 digestion D-68-9, P-356; P-120

food value F-144, 145, picture F-144a, chart F-144b legumes: beans B-65, S-224; peanuts

P-94; peas P-90

plants manufacture B-111, P-239, N-147, pictograph P-238b plastics from P-245j-k, 246 potatoes P-324

Proterozo'ic era, in geologic time G-40, 42, pioture G-41

Protesila'us (prō-těs-ĭ-lā'ŭs), in Greek mythology, the first Greek to go ashore in war against Troy; slain by Hector; in answer to prayers of grief-stricken Laodamia, his wife, he was permitted to return to earth for three hours, at the end of which time Laodamia returned to nether world with him.

Prot'estant Episcopal church, a religious body in U.S., resembling in doctrine and organization the Church of England, of which it became independent after Revolution ary War; membership about 1,735,-000.

Protestantism. See also in Reformation, Protestant; and chief denominations by name

chief denominations R-72 growth of C-232-3 missionary work C-233-4

origin of term R-66 unity, modern trend toward C-234 Proteus (pro'tē-ŭs), a sea-god in Greek mythology P-356

Prothal'lium, or prothal'lus, of ferns F-26, S-75

Protho'rax, the first segment of an insect's thorax, picture I-88 movable in beetles B-85

Protoactinium, a radioactive element R-34, C-176a, table C-168

Protohip'pus, an evolutionary ancestor of the horse, picture H-340 Proton, electropositive particle of an atom A-360-2

in cyclotron A-362, picture P-195 isotopes C-169, R-16 mass spectrograph studies R-16

packing effect C-169 radiation of R-13-14, 15-16 radium alpha particles R-32 weight A-360

Protone'ma, of moss M-270, picture M-271

Pro'toplasm, the basic material of all living organisms P-356, B-115 living organisms P-356, B-115 lhemical elements and structure B-109-10, B-112 chemical

Protozo'a, the single-celled animals as a group P-357, Z-227 amoeba A-188-9

disease producers G-77-80 paramecium, pictograph N-64a
"phosphorescence" of ocean caused
by luminescent forms P-176 place in animal kingdom A-199, dia-

gram A-200 termite partnership T-52a

Protractor, an instrument for meas-uring and constructing angles how to use G-48

Proudhon (prg-don'), Pierre Joseph (1809-65), French socialist and po-litical writer, imprisoned during Revolution of 1848 C-325

Proust (prost), Joseph Louis (1754-1826), French chemist; isolated a number of sugars

law of definite proportions, or constant composition C-167a

Proust, Marcel (1871-1922), French writer, born Paris; eminent as writer of subtle, detailed psychoeminent as logical novels; won Goncourt prize 1919 ('Remembrance of Things Past', series of novels including Past', series of novels including 'Swann's Way')
French titles of chief works F-199

influence on world literature F-198 Prout, Father. See in Index Mahony,

Francis

Prout, William (1785-1850), English physician and worker in physi-ological chemistry; believed that all the elements were compounds of one "mother substance," hydrogen.

Provenced (prô-viln-sâl'), old French dialect, spoken in Provence R-128 Provence (prô-vũns'), old province in se. France; annexed by France 1486: may F-179 language R-128

racial character F-172

Proveneher, Joseph Norbert (1787-1853), Canadian Roman Catholic prelate, born Nicolet, Quebec; 1818 became missionary in Northwest; 1847 made bishop of St. Boniface, Manitoba; founded St. Boniface College 1818.

Proverb, a short pithy saying in common usage expressing wisdom, as "Haste maketh waste."

Proverbs, Book of, twentieth book of the Old Testament, containing a collection of the sayings of the sages of Israel; a large proportion

ascribed to Solomon. Providence, R. I., cap. and chief city; pop. 253,504; P-357-8, map R-97 capitol, picture R-97 colonial town meetings R-96-7

founding celebrated H-321 Roger Williams founds W-104, pic-ture A-154

state representatives R-98

Providence College, at Providence, R. I.; Roman Catholic institution for men, founded 1917; arts and sciences.

Providence Plantations, first settlement in Rhode Island R-97

Providence River, in Rhode Island; fed by the Blackstone and Pawtuwet; empties into Narragansett Bay; navigable as far as Providence: map R-97

Province, in ancient Rome, a con-quered territory governed by a Roman official; in North America the term generally applies to a definite territorial division of Canada.

Provincetown, Mass., town at tip of Cape Cod peninsula; pop. 3668; picturesqueness of harbors, fishing boats, fisherfolk, and sand dunes attracts many artists: man M-82
Mayflower anchors at M-92

Provincetown Players, a theater group rovinectown Players, a theater group organized in Provincetown, Mass., in 1915, to "give American playwrights a chance to work out their ideas in freedom"; Susan Glaspell, George Cram Cook, and Eugene O'Neill were prominent in the group. Moved to New York City in 1916 and continued until 1929.

Provitamins V-312

Pro'vo, Utah, city on Provo River, 40 mi. s. of Salt Lake City hear coal and iron fields; pop. 18,071; canned goods, brick, iron products, candy; Brigham Young University; Provo Canyon, Utah Lake, and Bridal Veil Falls attract tourists: map U-264 Provost, fitlenne (1782?-1850), French Canadian fur trader; with Ashley's expeditions to Rocky Mountain regions (1822-26); was guide for Audubon (1843). City, river, and valley in Utah and city in South Dakota named Provo for him. Pro'vo, Utah, city on Provo River, 40

Prox'ima Centaur'i, a star S-273

Prudence and Melibeus, in 'Canterbury Tales' C-161

Prudhomme, Sully-. See in Index Sully-Prudhomme

Prud'hon (prü-dön'), Pierre (1758-1823), French painter, born Cluny, France; renowned chiefly for his paintings of classical subjects ('Psyche Carried off by Zephyrus'; 'Crime Pursued by Vengeance and Justice')

portrait of Empress Josephine, pio-ture J-228

Prune P-358

Prunel'la (from French prunelle plum, because of its original color) stout, smooth finished worsted cloth used for dresses and scholastic and ecclesiastic gowns, some-times for uppers of shoes.

Pruning, of fruit trees and vines F-214, G-136, picture F-212

Pru'nus, a genus of fruit trees C-182 Prus'sia, the largest and most powerful state of Germany; 114,527 sq. mi.; pop. 41,915,000: P-358-9, maps G-66, P-359. A list of the kings of Prussia will be found in the table in the next column

capital Berlin B-98-99b education E-176 history P-358-9, G-72-3, Outline history

Teutonic Knights help found C-407 Hohenzollern line H-318

Frederick the Great F-192-3 Silesia seized M-63 partition of Poland P-276, map P-278

Seven Years' War S-84-5 hostility toward French Revolution TC-202

Napoleonic wars N-8, N-10, W-48: results G-72 Congress of Vienna G-72 conscription adopted A-308

conscription adopted A-308
Revolution of 1848 P-359
Bismarck B-147-8
war with Denmark D-53, B-148
William I W-99-100
Seven Weeks' War with Austria
(1866) B-148, H-212
North German Confederation G-73

Franco-Prussian War F-187-8, See also Franco-Prussian War German Empire proclaimed at Versailles G-73, V-289

dominant in empire G-70, P-359 territorial changes P-359

Prussia, East. See in Index East Prussia

Prussia, West. See in Index West Prussia

Prussian blue C-177 in ink I-79

Prussic acid. See in Index Hydrocyanic acid

Prut (prgt) River, a tributary of the Danube in e. Rumania; 380 mi.: map E-326e

Prynne (prin), Hester, the leading character in Hawthorne's 'The Scarlet Letter', doomed to wear the scarlet letter.

Scarlet letter.

Pryor, Nathaniel (17757-1831), American trader, sergeant with Lewis and Clark expedition; operated trading posts at Arkansas Post, Ark., and on Verdigris, but did not prosper; lived with Osage tribe after marrying squaw (1820) and was made Indian sub-agent.

KINGS OF PRUSSIA AND EMPERORS OF GERMANY

Frederick I
Frederick William I
Frederick William I
Frederick William II
Frederick William III
Frederick William IV
William I (Emperor of
Germany 1871)
Frederick III
William II 1701-1713 1713-1740 1740-1786 1786-1797 1797-1840 1840-1861 1861-1888

1888-1918 [1918 Republic established]

(pshě'mish-ěl), Przemysl rzemysi (pshermish-el), Foland, town 50 mi, west of Lwow; pop. 48,000; thriving industries; timber and grain trade; Austrian fortress in World War besieged by Russians November 1914 to Mar. 22, 1915, when hunger forced surrender with when nunger forced sufference with 120,000 men; recaptured by Austrians and Germans June 2, 1915; maps W-156, E-326e
'Psalm of Life', by Longfellow L-192
Psalms, the 19th book of the Old Testament; contains 150 psalms, or humas

or hymns attributed to David D-19 Hebrew songs M-317 rhythmic prose W-187 tribute to music M-309

Psaltery, an ancient stringed instru-ment played with the fingers; one of the forerunners of the piano P-209

Psammetichus (săm-měť'i-kús), name of three kings of the XXVI dynasty of Egypt; under the first (664-610 B.C.) Egypt recovered its prosperity after internal wars and the Assyrian invasion; Psammetichus III reigned but six months, being de-throned 525 B.C. by the conquering Persians.

Persians.

Pseudonym (sū'dō-nim) (from Greek pseudōs, false, and onyma, name), a fictitious name, especially one used by writers; also called nom de plume, or pen name.

Pseu'dopod, or pseudopodium (false foot) a temporary projection from

de plume, or pen name.

seu'dopod, or pseudopodium (false foot), a temporary projection from the body of a single-celled organism, such as the amoeba, by which it

such as the amoeba, by which it

nyphotomic traphyce traphyce for hygrometer H-377, picture W-60b

Ptah (ptä), an Egyptian deity E-210

Ptarmigan (tär'mi-jān), the "snow

moves or takes in food amoeba A-188

Psiloriti (psē-lō-rē'tē), Mount, Crete C-394

Psittaciformes (sĭ-tăs-ĩ-fôr'mēz), an order of noisy, brilliantly feathered birds, comprising parrots, parobirds, compris

Psittacosis (sit-à-kō'sīs), influenza of parrots; contagious; communicable to man; symptoms are high

fever and pulmonary disorder.

Pskof (pskôf), Russia, also Pskov, old city near Esthonian border; pop. 60,000; flourished as free town and Hansa city in Middle Ages; conquered by Moscow (1510): map

Psocids (sos'idz), a family of small insects with well-developed wings, belonging to the order Corrodentia; found on trunks and leaves of trees, stones, walls, and fences; food is lichens, fungi, decaying vegetation.

Psyche (si'ki), in Greek and Roman mythology, beautiful maiden, bemythology, beautiful loved of Cupid C-413-4

Psychiatry (sī-kī'ā-trī), the branch of medicine that treats of mental disorders P-361, M-118 prisoners, work among P-350

Psychical Research, Society for S-259 (81-kö-a-năl'i-8is), Psychoanalysis (sī-kō-ā-năl'ī-sīs) a method of diagnosing and treating mental and nervous disorders P-362

mental disturbances E-262

Psychology P-360-3, Outline P-363. See also in Index Behavior and chief topics listed below adolescence A-21-2

advertising A-23-4 animal P-361 behaviorism P-362 bibliography P-363

brain, structure and function of B-222-4

branches of P-361 character C-140-3

child development C-199-202, C-203-

04b, B-3-4
color C-308j
conjuring employs M-32b
consciousness, human B-222
dreams S-163 emotion E-262, B-221-2, 223 gestalt theory P-362

habit H-193 heredity H-283-6 hypnotism H-377-8 illusions I-19-20 imagination I-20

individual differences I-71-3 industrial P-360, 361: work and fatigue W-147 instincts E-163

intelligence tests I-96-7 learning L-79-82 memory M-113 mental deficiency M-117-8 mental hygiene M-118

mind M-181 nerves N-64-

perception S-76-8 personality C-140-3 psychoanalysis P-362

reflexes R-63-4, B-221-2, 223 sensation S-76-8 sleep S-162-3

sociology uses S-184 study S-309-10 will W-98-9 work and fatigue W-147-8

Psychother apy, or mental therapy P-361, 362, M-109 hypnotism employed H-378

grouse" G-180, 181, pictures G-180, B-131

foot, picture B-129 PT's, boats M-291

Pteran'odon, flying reptile A-206-8

Pteria (të'ri-a), ancient capital of "White Syrians" (probably Hit-tites) of Cappadocia, Asia Minor according to Herodotus, captured and ruined by Croesus of Lydia (6th century B.C.); ruins near Bogaz Koi.

Pter'idophytes, the fernlike plants as a botanical group P-246, F-26

Pterodactyl (těr-ō-dăk'til), or pterosaur, prehistoric flying A-206, 208, R-78 reptile

Ptilogonat'idae, a family of birds B-132

tolemies (töl'ē-mis), line of Greek rulers of Egypt P-364, E-211 Alexandrian library founded by Ptolemies Alexandrian

L-103, A-116 Ptolemy I (died 283 B.C.), general of Alexander the Great and founder of the line of "Ptolemies" P-364, FC-211

founds Alexandrian library A-116, L-103

Pharos of Alexandria S-82, picture S-83 Ptolemy II, Philadelphus (809-247 B.C.), ruler of Egypt 285-247 B.C. extended commerce and encouraged

culture; maintained brilliant court and made Alexandria center of Greek civilization; sent explora-tions to Ethiopia and southern Africa

Pharos of Alexandria S-82, picture S-83

Ptolemy III. Euergetes ("benefactor") (died 222 B.C.), became ruler of Egypt on death of his father, Ptolemy II; his armies invaded Syria and India, and his fleets con-quered shores of the Hellespont and Thracian coast; under him Ptole-maic Egypt attained greatest prosperity and widest dominion.

Ptolemy XI, Auletes (died 51 B.C.), father of Cleopatra and Ptolemy XII, to whom he left the kingdom bust, picture E-336

Ptolemy XII (died 47 B.C.), brother and joint ruler with Cleopatra C-264

Ptolemy XIII (died 44 B.C.), youngest son of Ptolemy XI; ruled with Cleopatra until put to death to make way for her son Caesarion.

Ptolemy XIV, or Caesarion (died 30 B.C.), son of Cleopatra and ruler, with her, of Egypt P-364, C-264, 265

Ptolemy, or Ptolemaeus, Claudius, as-tronomer, geographer, mathemati-cian P-364, A-342

formulated idea of gravity G-140

Ptomaine (to'ma-in or to'man) pol-soning, term popularly but mis-takenly applied to food poisoning from supposition that the toxic action is due to chemicals called ptomaines. The poisoning is due to the action of certain bacteria (such as B. botulinus) rather than to direct chemical action. See in Index Botulism

Ptyalin (ti'á-lin), an enzyme D-68-9 Publs (pū/bis), the lower abdominal portion of the hip-bone S-156

Public address system T-37 Publicani, Roman tax-farmers R-134

Public Buildings Administration, U. S.

Public Contracts Division, in U. S. Department of Labor U-230

Public debt, debt incurred, usually by sale of bonds, by a government authority such as a nation, state, county, or city. See in Index Na-tional debt

Public domain. See Lands, public Public health H-254-7, H-370

Alaska A-106 bubonic plague controlled B-153 city problems C-240, 241 cockroach menace C-291 fly menace F-128-9 meat inspection M-98 milk inspection D-4-5 mosquitoes M-266-70

Panama Canal P-46, G-122, picture Philippines P-167

progress in control of diseases, pictographs H-255, 256 pure food laws P-368d-369

agricultural imports quarantine: agricultural imports I-110d; animals Z-220-1; conta-gious diseases H-257

rat menace R-51-2 Rockefeller activities R-122 sewerage S-87

Social Security Act aids S-179 waterworks W-53-6 Public Health Service, U. S. H-257,

U-232 flag F-93, color plate F-87 New Orleans N-103 nursing N-186

Public Information, Committee on, U. S. (1917–18) W-169, W-110 Publicity A-24b. See also in Index Advertising; Propaganda Barnum's method B-49 football publicized by Camp F-1510 motion picture industry M-289 source of news N-109 World War (1st) W-169

Public lands L-59-60. See also in Indew Lands, public

Public libraries. See in Index Libraries Public opinion. See also in Index Censorship; Propaganda advertising affects A-23-24 Fascist state control F-18

magazines influence M-26 newspapers influence N-107 publicity agents A-24b radio and R-31a-b, C-324b

Public relations counsellor A-24b Public Roads Administration U-232 Public Safety, French Committee of F-204, R-117

Public school S-40-1. See also in Index School

Public service corporations C-371

Public utilities P-364-5. See also in Index Government ownership; Government regulation of industry; Municipal ownership; also names of public utilities Interstate Commerce Commission

public service corporations C-371 Tennessee Valley Authority T-49 Utilities Holding Company R-146j

Public Works, Federal Emergency Administration of (PWA) R-146g, e

Public Works Emergency Housing Corporation (PWEHC) R-146f

Publishing and publishers B-189-91. See also in Index Books and book-making; Periodicals ancient times B-189 children's story-books L-157-8 Leipzig a center of L-93

modern methods B-190-1 payment of authors: early times B-190, 191; modern royalties B-191 prices and discounts B-190-1 subscription books B-190

Puccini (put-chē'nē), Giacomo (1858— 1924), Italian operatic composer, of

musically talented family; operas are melodious and dramatic 'La Bohême' O-229 'La Tosca' O-234, picture O-230 'Madama Butterfly' O-231 'Manon Lescaut' O-231

Puccoon (pu-kgn'), several perennial plants of the gromwell genus. Redroot or Indian paint (Lithospermum canescens) ĥas orange-yellow, saucer-shaped flowers and is found from Ontario to Texas. Roots are red, long, and deep. A Rocky mountain species has pale yellow flowers.

Puck, or Robin Goodfellow, in 'Mid-summer Night's Dream' M-162 Puck, in game of hockey H-314

Pudding stone. See in Index Con-glomerate rock

Puddle butterfly, or clouded sulphur butterfly, color plate N-38a-b Puddling, in iron manufacture I-142

Pu'du, smallest known deer D-37 Puebla (pwā'bla), state in s. cent.

Mexico; 13,124 sq. mi.; pop. 1,150,-000; cap. Puebla (7500 ft. above sea).

Puebla, Mexico, railroad and manufacturing center 60 mi. s.e. of Mexico City; cap. of state of Puebla; pop. 115,000; textiles, glass, straw hats; onyx quarries near by; headquarters of Carranza in 1914; has fine cathedral: M-142, map M-133

Pueblo (pweb'lo), Colo., 2d city in state and one of most important industrial centers w. of Missouri River; heart of agricultural section; on Arkansas River, 115 mi. s.e. of Denver; pop. 52,162; i and steel products: map C-310 iron

Pueblo, name for Indian village in s.w. United States P-365, A-147 Acoma N-96, picture N-95 Walpi, picture I-55

Pueblo, name given to non-military town by Spanish colonizers S-223 Pueblo Indians P-365, I-55

Arizona A-290, picture A-291 burial custom I-66 Eagle dance I-63

houses P-365, I-60, pictures I-55. N-95

New Mexico N-99: Acoma N-96, pioture N-95; corn dance, picture F-11

practised irrigation I-148 social organization F-11

Puerto Barrios (pwār'tō bä'rē-ōs). chief Atlantic port of Guatemala; pop. 8000; terminus of transcontinental railroad; chief export bananas: map C-132

Puerto Cabello (kä-bā'yō), a city and port of Venezuela; 65 mi. w. of La Guaira; ships hides, coffee, cacao; has national dry dock and navy yard; pop. 22,000: map V-276

Puerto Colombia, port on n. coast of Colombia, serving as ha Barranquilla: map S-208b harbor for

Puerto Cortes (kôr-tās') (formerly Caballes), Honduras, port on n.w coast on Gulf of Honduras; pop 10,000: map C-132 railroad terminus H-330

Puerto Mexico (Coatzacoalcos), Mex ico, petroleum shipping port on Gulf of Mexico; terminus of r.r. across Tehuantepec Peninsula: M-142

Puerto Montt (mont), Chile, seaport about 600 ml. s. of Santlago; pop. 16,000; in timber and agricultural section; tourist center: C-206, 2070, map C-208

Puerto Rico. See in Index Porto Rico Puff-adder, a poisonous snake V-303 hog-nosed snake mistakenly so called S-173

Puff ball, a mushroom, color plate, M-306a-b

Puffed grains, breakfast cereals B-233 Puffer, family of curious marine fish (Tetradontidae); stomachs capable of enormous distention. When taken from water, they distend boo with air until it resembles a ball.

Puffin, a bird of the auk family A-365 "Puffing Billy," an early locomotive R-36

Pug. a dog D-83

Puget (pü-zhê'), Pierre (1622-94), French sculptor, painter, and architect; best known for powerful sculptural works ('Milo of Crotona' and 'Alexander and Diogenes' in Louvre; 'St. Sebastian' in church at Genoa): S-59

Puget (pū'gėt) Sound, large inlet of Pacific Ocean entering state of Washington at n.w. corner; begins at junction of Straits of Juan de Fuca and Georgia and extends south: W-29, S-71b, map U-188b salmon fishing, picture W-31

Puget Sound, College of, at Tacoma, Wash.; founded 1888 by Methodist wash, founded 1888 by Methodist Episcopal church; arts and sci-ences, education, graduate school. Puget Sound Navy Yard. See in Index Bremerton, Wash. Pug mill, clay-mixing machine B-236,

picture B-237

in pottery making P-328

ul (pŭl), or Pulu. See in Index Tiglath-Pileser III or IV

Pulaski (pa-lüs'kē), Casimir (1748–79), Polish count and American Revolutionary hero P-365 flag F-99, color plate F-90

Pulaski, Tenn., town 70 ml. s.w. of Nashville, in agricultural and stock-raising district; pop. 5314: man T-46

Ku Klux Klan organized T-48-9 Fulci (pul'ohê), Luigi (1432-87), Italian poet remembered for 'II Morgante Maggiore', epic based on adventures of Roland; works said to have been read by Shakespeare.

Pulitzer (pū'līt-sēr), Joseph (1847—1911), American journālist, born Budapest, Hungary; came to U. S. 1864 and served in Civil War; proprietor St. Louis Post-Dispatch and New York World; pioneer in use of "human interest" stories; founder of Pulitzer School of Journalism. Columbia University, and of Pulitzer prizes. (Biography by Don C. Seitz, 'Joseph Pulitzer, His Life and Letters.')

Pulitzer prizes, provided for in will of Joseph Pulitzer and awarded annually under control of Columbia University for excellence in American newspaper work, novel, drama, history, biography, and verse.

Pul'kas, sledges of Lapps L-64 Pulkovo (ppl'kô-vů), Russia, also Pulkowa, village 10 mi. s. of Len-ingrad; seat of famous observatory. Pulley, a mechanical device M-104-5

Pullman, George Mortimer (1831-97), American business man; man; man; ufactured Pullman sleeping cars, for which he designed the folding berth; built model town of Pullman, Ill. (now part of Chicago) for his employees.

Company strike. (1894) Pullman C-267

Pullman sleeping car R-39

Pul'monary artery II-258, pictures II-258, L-219

Pulmonary circulation H-258-9, pic-ture L-219

Pulmonary valve, picture H-258 Pulmonary veins, pictures H-258. L-219

Pulmonate snails, snails with lunglike organs S-168

Pul'motor, instrument to produce artificial breathing, picture F-56

Pulpwood, wood from which pulp for paper manufacture is made; chiefly coniferous trees.

Pulque ($pul'k\bar{a}$), Mexican beverage M-137

Pulse, a collective term for leguminous vegetables such as peas, beans, and lentils.

Pulse, rhythmic beating of the ar-teries P-365 affected by emotion E-262

Pultova, or Pultowa (pul-tō'va). See

in Index Poltava

Pultusk (pul'tusk), Poland, manufacturing and trading town on Narey, 30 ml. n. of Warsaw; pop. 16,000; Charles XII of Sweden defeated Saxons and Poles (1703), and French fought Russians (1806).

Pu'lu, fern F-26

Pu'ma, mountain lion, or animal of cat family P-365-6 Pum'ice, a spongy form of lava L-73,

M-184

Pump P-366, pictures P-367, W-48 centrifugal type, picture D-105 Chinese irrigation pump C-221, picture C-221a

force pump P-366, picture P-367 hydraulic ram H-366, picture H-367 suction pump P-366, picture P-367

Pumpelly, Raphael (1837-1923),
American geologist and traveler,
called "the Marco Polo of the scientific world"; born Owego, N. Y.;
made geological explorations in
Corsica, Arizona, Missouri, China,
Japan; professor of mining engineering, Harvard University, 186673: state geologist of Michigan: 73; state geologist of Michigan; with U. S. Geological Survey, 1879-81 ('Travels and Adventures').

Pum'pernickel, a rye bread R-202 Pump'kin P-366

gourd related G-124 how to plant G-13 squash distinguished S-265

Pumpkin ash, tree (Frazinus pro-funda) of olive family, found in Mississippi valley from s. Illinois to Guif of Mexico, e. to n. Florida; also in w. New York. Wood light and similar to black ash: A-323

Puna, India. See in Index Poona Punans, a tribe in Borneo B-196 Punch, a tool T-111, 112

'Punch, or the London Charivari', English humor magazine, first published 1841; first editor, Mark Lemon, a playwright and magazine writer; began as champion for social improvement and as expression of humanitarian opinions; excellent caricatures; famous con-tributors: Douglas Jerrold, Thomas Hood, W. M. Thackeray, Artemus Ward, Andrew Lang, A. A. Milne Thackeray T-71
Punch and Judy show, a type of pup

pet show particularly popular in England, in which the mock hero, Punch, a hunchback with a long hooked nose, quarrels with his wife, Judy, and has many farcical ad-ventures; originated in Italian puppet character Punchinello. See also in Index Puppets

Puncheons P-2210

Punctuality in character education, Outline C-143 Punctuation P-366-8, G-127

Pu'nic Wars, series of conflicts be-tween Rome and Carthage (264-146 B.C.) C-88-9, R-133-4 Hannibal H-211-12

Spanish mines a cause S-152 Punishment, of criminals P-348-50 Babylonia, Hammurabi's code B-6 courts of justice C-385-6: Star Chamber S-276

jury determines guilt J-229-31 ostracism A-282-3, picture G-155 pardon U-215, P-350

parton U-215, P-350 stocks and pillory, picture A-162 torture P-348-9: medieval instru-ments P-349, N-186 Punjab (pūn-jūb'), rich agricultural and manufacturing region in n.w. India consisting of British province India consisting of British province of Punjab (area 99,200 sq. mi, pop. 23,880,000); Punjab States, Indian territory (area 5820 sq. ml., pop. 440,000); and Punjab States Agency, Indian territory (area 31,241 sq. mi., pop. 4,475,000); wheat and textiles: I-31 Pulbi D-44

Delhi D-44 Indus River I-73d irrigation I-148 Kipling in K-24

Punks, boy workers at the circus C-237e

Punt, in football F-150, pictures F-151b, d

Punta Arenas (pun'tà à-ra'nas), Chile. See in Index Magallanes

Punta Borinquen, Puerto Rico, a cape at n. w. corner of the island; U. S. military base,

Puntarenas, city on Pacific. port of Costa Rica; pop. 8000: C-374

Punxsutawney (pŭnks-u-ta'ni), Pa., center of great bituminous coal and coke region, about 70 mi. n.e. of Pittsburgh; pop. 9482; railroad Pittsburgh; por shops, foundries.

Pupa, the quiescent stage intervening between larva and adult in insect

metamorphosis P-868, I-85-6
bee: carpenter, picture B-77; honeybee B-74, picture I-87
beetle: Calosoma, pictures B-82;
Japanese, pictures I-93; rove, pictures B-83

butterfiles and moths B-284, C-99, pictures B-286, C-99, color plate B-283a-b housefly F-128

mosquito, pictures M-267

Pupil of the eye E-349, diagram E-349 Pupin (pũ-pēn'), Michael Idvorsky (1858–1985), American scientist and inventor P-368–368a

Puppets and marionettes P-368a-d books about H-313n

Chinese shadow play, picture C-221f Faust legends in plays F-20, P-368b making and using in plays P-368c-d Pinocchio, picture L-112

theater, making, picture V-266g Pup tent, picture C-45

Puranas (pu-rä'naz), collection of books (18 in number), written mainly in Sanskrit verse, expoundcollection of ing ancient Indian lore-mythology, history, religious beliefs, philoso-phy, social and political thought; also legends, old songs, fables, etc.: H-293, I-41

Purcell (pûr'sēl), Henry (1658-95), English organist and musical composer; considered one of best sacred composers of his day; both his church music and his dramatic compositions have won enduring appreciation: M-311

Purdue University, state institution at Lafayette, Ind.; organized 1869, opened 1874; agriculture, engineer-

ing, science, pharmacy, home economics; agricultural and engineering experiment stations bacteriology class, picture E-185 Pure food laws P-368d-369, U-231 advertising regulated A-24a, F-22 butter fat, picture B-282 candy C-72 glucose G-107 oleomargarine regulation O-223 preservatives A-223: formaldehyde prohibited F-160; laws P-368d-69 Theodors Roosevelt initiates R-151 U. S. P. drugs D-114 vinegar V-300

Purgas, blizzards in Siberia S-136 Pur'gatory, according to Roman Catholic doctrine, the temporary abode and place of punishment for souls that have died in a state of grace, but have not yet fully paid the penalty for their transgressions; a place of purification

Dante's 'Divine Comedy' D-12

Puri (pw'rē), India, also Jagannath, town on e. coast noted for temple to Jagannath, built in 12th century; pop. 38,000.

Pu'rim, a Jewish festival commemorating story of Esther E-306
"Puritan Poet" M-176-80

Puritan Revolution. See in Index Civil War, in England Puritans and Puritanism P-369

America U-235 Boston, center of B-202-3 interpreted by Hawthorne H-248,

Maryland M-78 Massachusetts M-86 Newark, N. J. N-80 Plymouth Colony A-151, P-261-3,

Roger Williams W-104 Bunyan imprisoned B-274-5 for belief

Calvin's influence C-35 Charles I and C-148, 149 Cromwell and Civil War in England C-400-2

festivals prohibited C-229a, c-d, M-91 first Sunday service in America, picture A-150

hats H-236 influence on English literature E-285 James I and J-182, P-369 Milton champions M-178

theaters closed D-94 'Purity', a Little Talk by Arthur Mee P-370

Purkinje urkinje (pyr'kin-yč), Johannes Evangelista (1787–1869), Bohemian physiologist; professor of physiology physiologist; professor of physiology at Breslau and Prague; established physiological laboratory at Breslau 1824 which was the beginning of laboratory training in German uni-versities; 1823 recognized import-ance of finger prints; 1833 dis-covered sweat glands of the skin; 1837 discovered the ganglionic cells (called Purkinje cells) in the cere-bellum; ploneer in microscope tech-nique. nique.

Purnell Act (1925) A-55 Purple, color, color chart C-308c derived from murex, picture S-107 dye of Phoenicians D-121, P-174 mixtures C-308f-i secondary color, picture C-308b

"Purple and fine linen" L-148 Purple grackie B-152-3

Purple Heart, U. S. Army decoration.

See in Index National Order of
Purple Heart

Purple loosestrife. See in Index Lyth-

Purple martin S-332 food habits B-122 houses B-142, picture S-838 Purple of Cassius, a pigment G-114 Purpura, a shellfish eggs, picture E-193

Purpure, in heraldry H-281 Purse-seine, a fish net F-81, pictures

F-80, W-31 Purs'lane, an annual herb (Portulaca oleracea) of the purslane family with trailing stem, fleshy leaves,

and small pale yellow flowers; usually considered a weed, but leaves sometimes eaten as greens, par-ticularly in Europe; sometimes called pusley: W-64

Purslane family, or (por-tū-lā-kā'sē-ē), or Portulacaceae \bar{e}), a family of plants and small shrubs which includes the portulaca, or rose-moss, red maids, spring beauty, bitter-root, winter-pursiane, and fameflower.

Pursuit plane, a high-speed military plane A-307, picture A-74h

Purus (pgr'gs) River, one of chief southern tributaries of the Amazon; navigable for 800 mi. of its 1850 mi. course: map B-226

Pus B-1000 Pusey $(p\bar{u}'z\bar{i})$, Edwar English Pus B-157a Edward Bonverie theologian, leader in Oxford movement.

Push'kin, Alexander (1799-1887), greatest Russian poet; also drama-tist and short story writer; his gentle humor and keen wit pro-duced some of the best epigrams in any language; originally imita-tive of Byron, his later work was entirely original in character and method: R-196

chief works R-197 folk-tales S-303c-d

Pushmataha (1764-1824), Choctaw Indian chief, born Mississippi; friendly to whites; ceded lands in Alabama and Mississippi (1805) for \$500 and small annuity, resisted Tecumseh's efforts toward a southern confederacy, fought on American side in war of 1812 and Creek

Push-pull amplification, in radio, diagrams R-23, 25

Pushtu (pŭsh'tu) language spoken in Afghanistan A-29

Pusley, or pussly. See in Index Purs-

'Puss in Boots', a French folk-tale F-134

Pussy willow, or glaucous willow W-104b-5

Put and call. See in Index Economics, list of terms

Put in Bay, Ohio, harbor and village of South Bass Island in Lake Erie, about 15 mi. n. w. of Sandusky; once exclusive, it is now open to tourists

Perry memorial P-126

Putnam, Amelia Earhart. See in Index Earhart, Amelia

Putnam, George Haven (1844-1930) publisher, born London, England, of punisher, born London, England, of American parents; during Civil War became a major in Union army; became president (1872) of G. P. Putnam's Sons, the publish-ing firm founded by his father; largely responsible for copyright acts of 1891 and 1909 (Question of Copyright'; 'Abraham Lincoln'; 'Memories of a Publisher').

Memories of a Publisher).

Putnam, Herbert (born 1861), American librarian, born New York City; practised law in Boston; librarian Boston Public Library, 1895-99; while librarian of Congress, Washington, D. C., 1899-

1939, greatly expanded scope of institution; librarian emeritus of Congress after 1939.

utnam, Israel (1718-90), Revolutionary soldier P-371 at Bunker Hill B-271

Putnam, Rufus (1738-1824), ican general, cousin of Israel Put-nam; served in Revolution in New England campaigns; one of organizers of Ohio Co. of Associates Marietta, Ohio, founded by O-214

Putrefac'tion B-12, B-116 fermentation similar F-24 Putt, in golf, picture G-117 Putter, a golf club, picture G-118

Putting-out system, cottage industry, or domestic system, of manufacturing I-74a-b, E-275 Japan J-188

Putty P-371

Putty knife, a tool T-110

Putumayo (pg-tg-mä'yō) River, in S. America, rises in Andes in s.w. Colombia, flows s.e. about 800 mi. to Amazon: map C-305

Puvis de Chavannes (pil-vē' dǔ shā-vān'), Pierre (1824-98), French painter; restored the purely decorative function of mural painting; (grand staircases of Boston Public Library, Paris City Hall).

Pu-yi (born 1906), the last peror of China, succeeded 1908 as Emperor Hsuan-tung; dethroned 1911 by revolution; temporary restoration 1917; title of emperor abolished 1924; named ruler of Manchukuo and enthroned as Emperor Kang-teh 1934: M-49a, b, C-2211

Puzzle-problems, in arithmetic A-287 Puz'zolau, or slag, cement C-125

PWA (Federal Emergency Adminis-tration of Public Works, better known as Public Works Administration) R-146g, e

ydna (pid'na), Greek town in ancient Macedonia on Thermaic Gulf; subdued by Macedonian kings; victory of Romans under Aemilius Paulus over Perseus, last king of Macedonia (164 B.C.).

Pye (pi), Henry James (1745-1813), English poet laureate 1790-1813.

Pygmalion (pig-mā'li-on), in Greek legend, a sculptor who fell in love with an ivory statue he had made: Aphrodite granted life to the statue, so that Pygmalion might marry her; story told in Ovid's 'Metamor-phoses', used in Gilbert's comedy 'Pygmalion and Galatea', also in George Bernard Shaw's play 'Pygmalion'.

Pygmy. See in Index Pigmy Py'gostyle, tail-bone of birds B-120

Pyle (pil), Howard (1853-1911), American artist and author, born Wilmington, Del.; did brilliant work as decorative painter and as an illustrator, especially of children's books; skilled in depicting Amer-ican colonial life and days of chivalry and adventure; illustrated his own books ('The Merry Adventures of Robin Hood'; 'The Story of Sir Launcelot and His Companions'): L-162, S-303g
'Champions of the Round Table',
picture L-119

'Robin Hood', picture L-116

Pyle, Katharine (died 1938), author and artist, sister of Howard Pyle; wrote fanciful stories, poetry and folk-tales for young children ('The Counterpane Fairy'; 'In the Green Forest'; 'Nancy Rutledge'; 'Lazy Matilda'; 'Fairy Tales from India').

Py'lon, in architecture a gateway: in Egyptian architecture one hav-ing truncated pyramidal form Egyptian, pictures E-208, 205

Pylo'rus, or pyloric orifice, of stomach P-206, S-292

Pym (pim), John (1584-1643), English Puritan statesman, parliamentary leader, conspicuous in struggle against Charles I John Hampden and H-206

Pynchon, William (1590-1662), colo nial magistrate, born Springfield, Essex, England; came to America, 1680; settled site of Springfield, Mass., 1636, and named it for his English birthplace.

Pyorrhoe'a, a disease of the sockets of the teeth.

Pyralin, a synthetic plastic P-246

Pyr'amid, in geometry, a solid having a polygon as base; sides are tri-angles meeting at a common point, the vertex: picture G-49 volume M-116

Pyramid Lake, Nevada; 30 mi. long; at elevation of 3880 ft. above sea; receives Truckee River from South: N-76, 79, map N-77

Pyramids, famous tombs in Egypt P-371-2, E-203-4, pictures E-196,

C-18, P-371, 372 architecture interpreted A-257 building methods B-263, A-257, pio-

tures P-371, A-264 reat Pyramid C-16-17, P-371-2, pictures P-371, 372, E-196, C-18

time it took to build E-204

Pyramids, in Mexico and Central America A-147, M-142b, d Mayan temple at Uxmal, picture A-148

Pyramid of the sun, picture M-142c Pyramids, battle of the (1798), vic-tory gained near Egyptian pyra-mids by French under Napoleon over Mamelukes under Murad Bey N-7. E-199

Pyramus (pir'a-mus), hero of the

classic story of Pyramus and Thisbe, parodied in the interlude of 'Midsummer Night's Dream': M-162

Pyrenean sheep-dog D-83 Pyrenees (pir'i-nez), Peace of (1659), between France and Spain; pro-vided for marriage of Louis XIV and Si Spanish princess,

Pyrences Mountains, between France and Spain; highest peak, Pic Méthou, 11,168 ft.: P-372, map F-179 iron S-227

retard Spanish commerce S-228 Pyrethrum (pir'eth-rum), an old genus of composite plants which botanists now place in the genus Chrysanthemum. Most of the garden varieties of pyrethrum have been derived from Chrysanthemum been derived from Chrysanthemum roseum (Pyrethrum roseum), a handsome perennial, popularly called painted daisy, with finely dissected leaves, and white, pink, rose, crimson, and lilac flower heads; the pyrethrum flowers of this and other species are used in manufacture of insecticides how to plant G-II

Pyrethrum powder S-263 Pyrex, trade name for a heat-resist-ing glass B-192 Pyrgos, Bulgaria. See Burgas Pyridoxin (vitamin B₆) V-311a, 312 Pyrites (pī-rī'tēz), or foo a disulphide of iron M-182 fool's gold, copper-bearing C-361 sulphur and sulphuric acid from S-324

Pyrolaceae (pir-ō-lā'sē-ê). See in Index Shin-leaf family

Pyrolusite (pî'rō-lü'sīt), a soft metallic black or gray mineral, manga-nese dioxide M-182, M-53

Pyrom'eter, an instrument for measuring high temperatures P-373 thermoelectric action E-226 Py'rope, a variety of garnet G-28 Pyrophoric alloys, used to produce sparks C-176 Pyrotechnics (pī-rō-těk'nīks), making or using fireworks F-60-2

Py'rexene, a large group of silicate minerals next to feldspars the commonest rock-forming constituents they contain mainly calcium and magnesium besides silica: M-184,

Pyroxylin (pi-röks'i-lin), or collodion cotton, cotton treated with nitric acid P-373, C-123 collodion C-302 derivatives, chart C-123 plastics P-373, P-2461, 246 rayon, Chardonnet process R-53-5 shatter-proof glass G-104 Pyr'rha, in Greek mythology, wife of Deucalion D-58

"Pyrrhie (pir'ik) victory" P-374 Pyr'rhotite, an iron sulphide ore, M-182

Pyrrhus Pyrrhus (pir'ūs), king of Epirus (318?-272 B.C.) P-373-4 aids Greek citics R-132 defied by Rome, picture R-135 Pyrrhus, in Greek mythology. See in Index Neoptolemus

Pythagoras (pī-thā g'ō-rās) (582?-500 B.C.), Greek philosopher and mathematician P-374

discovers vibration ratios S-198 geometry G-46

Pythagore'an the'orem G-46 Pyth'eas, Massilian navigator of 4th century B.C. G-34

Pyth'ia, priestess of Delphi D-44 Pythian games A-228, D-44 Pythias, Damon and D-10

Pythias, Knights of D-10

Pythis, or Pythius, Greek architect and sculptor of 4th century, said to have sculptured part of the Mausoleum of Halicarnassus.

Py'thon, serpent in Greek mythology. slain by Apollo A-228

Python, a snake P-374 boa distinguished from B-160 egg, picture E-193 food in captivity Z-223 method of capturing Z-219